THE

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THE

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THE USE OF GAS AND ELECTRICITY.

SOME few weeks ago one of our building contemporaries, in summarising what is considered the peculiar condition of London gas affairs, stated that: "In spite of the increasing adoption of the electric light, the annual output of gas continues to increase, and has reached a volume almost inconceivable in its magnitude." The most pessimistic holder of gas shares could hardly fail to be favourably impressed with such a statement, and we feel sure that no member of the great rival industry would be sorry to learn that gas companies are generally having a good time. It is not long ago that orators on electrical subjects endeavoured to modify the scare among that section of the public interested in gas companies, by pointing out that wherever electricity had been adopted for lighting the gas company had gained in prosperity. If gas were used only for illuminating purposes, such a statement would soon cease to possess any significance, for it can hardly be doubted that the growing use of electricity must have had an appreciable effect on the consumption of gas for merely lighting purposes. It is not difficult, however, to ascertain the real cause of the continued prosperity of gas undertakings, for Mr. George Livesey, the chairman of the South Metropolitan Gas Company, declared in evidence before a Select Committee of the House of Commons that 50 per cent. of the gas sold by his company was used for purposes other than lighting. Unless some extraordinary changes take place in the method of utilising gas for illuminating purposes, electricity ought in the very nature of things to supplant it as a lighting agent; but what a long road to travel before we reach such a desirable consummation! At the present moment in some of the larger towns there is probably sold twenty times as much gas as electricity, and if such a demand were to be met by electrical works it would need a radical departure from the present system of carrying out extensions.

It is, of course, difficult to estimate precisely what effect the introduction of the Welsbach burner has had upon the electricity supply industry, for hitherto the only limit to the increased use of electricity has arisen from the difficulty in obtaining the necessary electrical machinery. In all probability the introduction of the incandescent burner has caused many people to retain gas, who otherwise would have adopted electric lighting, and it cannot be denied that it possesses some marked advantages. At the same time the disadvantages of the system are apparent, and in spite of the improvements effected from time to time, it cannot be expected to reach the pitch of perfection by providing a light that burns in a vacuum, and thus guarding against the vitiation of the atmosphere. The breakage of delicate mantles has still to be reckoned as part of the system, but according to our contemporary, other causes have tended to prevent the wider use of incandescent gas mantles, for we read that, "Owing to

the manner in which the incandescent burner and mantle business has been handled in this country, the cost of every mantle to the London gas consumer is some 300 per cent. higher (1s. instead of 3d.) than to consumers in certain Continental towns. Similarly, the prices charged for incandescent burners are, in this country, absurdly high. Ceaseless litigation, and what we must consider the over-capitalisation of a great company, is largely responsible for the fact that in past years London consumers of gas have paid far too heavily for incandescent gas appliances, and the friends of the gas industry will have cause to rejoice when the master patents expire, and mantles and burners can each be purchased for a few pence apiece." If our contemporary is correct in its views, the rivalry of the incandescent gas burner might have been a more formidable affair than it has proved; but one cannot help remarking that, in spite of the cheapness of gas mantles on the Continent, electricity undertakings there do not appear to have suffered to any great extent. Probably by the time the master patents of the gas burners expire, a form of incandescent electric lamp may have been evolved, which will ensure for electricity a continuance of past favours; we have already indicated the direction in which investigators are working.

It cannot be denied that of late years the gas companies have shown remarkable activity in developing the use of gas for heating and cooking purposes, and doubtless the greater portion of the 50 per cent. of which Mr. Livesey spoke goes in this direction. Both as a means of cooking and heating gas has proved itself to be an economical agent, and the hiring out of appliances has aided very materially in advancing this side of the business. With even greater facility electricity can be applied to similar purposes, and that the merits of electric heating are fairly widely appreciated is evident from the use that is made of electrical heating appliances. The electric heater itself is probably one of the most efficient devices in existence, but it is doubtful, under present systems of generation, whether it will ever achieve a popularity similar to that of gas. We are not unmindful of the fact that electric heating possesses the features of cleanliness, convenience, and facilities for regulation and control that render it unapproachable under certain conditions, but, unfortunately, it is likely to remain expensive for some time to come. Mr. Alton D. Adams, in investigating the various systems of heating, showed the total combustive energy which could be derived from different devices. Steam heat, with good boilers, gave 70 per cent., steam heat, with ordinary house boilers, 40 per cent., hot water heat, with ordinary house boilers, 40 per cent., heat from stoves, 30 per cent., and heat from electric heaters, 7 per cent. The unfavourable position occupied by electricity arises from the losses in the boiler, the steam engine and dynamo, and the conducting medium. As we have indicated, there are many directions in which electric heating might be used with advantage, and in some cooking operations where the cost of labour was high compared with the cost of heat, there might be a favourable field, but for general every-day use there does not appear to be any immediate prospect of electricity competing very seriously with gas.

Where electricity can be obtained for motive power purposes, there does not appear to be any great likelihood of its being ousted by gas, for gas motors have none of the facilities of starting or of regulation that are possessed by the electric motor.

There are certain directions, however, in which gas ought to have been used to a greater extent, that is, in the driving of electric generators. We are not unmindful of the splendid work that has been done in private installations, but we have rather in view the use of gas in driving large public electricity works. It is true that two or three of the public instances in which gas-driven electric generators have been employed, have been comparative failures, but the causes are clear, and if they are properly recognised by gas engine builders, similar troubles are not likely to occur again.

There are many electrical men who are convinced that the most economical method of distributing electricity through a town would be to place dynamos and gas engines at sub-stations and utilise the gas from the street mains for driving purposes. Such a scheme has much to recommend it, but it is doubtful whether the modern gas company would appreciate it sufficiently to bring down the price of a gas to a point at which the experiment could be tried. There was a time, not far distant either, when the gas companies of this country, by adopting some such policy, could have controlled the future of electricity supply; they missed their opportunity and have had to face a competition, which, with the apparently limitless possibilities before electricity, is bound to become more severe from year to year.

Viscosity.—A discourse, given by Prof. H. S. Hele-Shaw at the Royal Institution seven months ago, on "The Motion of a Perfect Liquid," has at last, after many retardations and eddyings, trickled through to the press, and appears in the form of an illustrated article in the *Engineer*. We are first shown diagrams representing the stream lines in the case of water passing through channels of various forms, and the tumultuous conditions under which water moves when it has to dodge through sluices, or along narrow river beds. The effect of a widening in the waterway is next discussed, the inertia of the particles is considered, and we are led to see that the impact of the particles in the wider portion necessarily involves greater pressure in that part. By introducing colouring matter or air-bubbles into the water, bands appear, whose widths indicate the local velocities and pressures. Having then determined the pressure at every point of the liquid, the directions in which the particles are moving, and their velocity at every point, we may know, or may think we know, all about its motion. Unfortunately, at this juncture viscosity comes into the problem, and hence arise immense differences between the flow of an actual liquid and the behaviour of a so-called "perfect" liquid. Viscosity turns out to be the cause of half the troubles and all the sea-sickness of the universe, but with some compensations. If there were no viscosity there would be no waves raised by the wind, there would be no tidal flow, rivers would move with incredible velocity, and rain would fall in one big unhesitating drop.

Naming the Motor Carriage.—Let it not be thought that there is an end to the American controversy as to what we are to call a motor carriage. Mr. C. E. Woods, of Chicago, does not allow our contemporary, the New York *Electrical Review*, to have it all its own way, for, although to our namesake's mind the matter was settled once and for all, he suggests to the public in the American *Electrician* a name claimed to fulfil all requirements:—

> That is the name *autobaine*, which, translated, means automatic waggon, *baine* being derived from an old Greek word, meaning waggon; so we have for the name of the vehicle, *autobaine*, *autobaineer*, as applied to a man operator, *autobainess*, as applied to a woman operator, and *autobaining* or *autobaineering* for the act of using the vehicle, in addition to which, this name is applicable to any kind or form of self-propelled vehicle.

THE GLASGOW CORPORATION CONTRACT.

Since our article of last week we have had the opportunity of perusing the specification of Mr. Parshall, which it will be remembered was issued as a guide, not as a binding specification. He states that he wished to allow the "fullest latitude" to contractors. Now, from the letters of the Allis Company and Messrs. Hick, Hargreaves & Co., it appears that the dimensions given by Mr. Parshall are some of the points in dispute. Though not forming a part of the obligatory specification, these dimensions are there, and may be assumed to represent Mr. Parshall's ideas of design. They are endorsed by the Allis Co. as the best practice. There are two alternatives in the specification, but both are for engines of 75 revolutions, 150 lbs. pressure, and for 2,500 KW. capacity. In each the stroke is the same, and it may be assumed that the cylinders should be the same. Yet in one case the H.P. cylinder is to be 42 inches diameter, in the other 44 inches. We do not think much of this discrepancy. H.P. cylinder proportions may be varied with little or no difference in economy. The difference, however, is there, and appears needless.

Two 60-inch L.P. cylinders in one engine are assumed to be the equivalent of one 88-inch L.P. cylinder in the alternative. Is not this serious? Allowing for the rods, it amounts to almost exactly 8 per cent., and it is 8 per cent. the wrong way, for had any difference been made it should have been in the other direction.

Then, again, the diameter of the piston rods for 60-inch and for 88-inch cylinders is given as 10 inches. Is not this altogether wrong? When Messrs. Allis claim it as good practice, we feel inclined to ask them, Is this your practice? because if it is, your practice does not seem correct. At first we could hardly believe it was Messrs. Allis's practice, and were inclined to set down their letter as so much sheer bluff on this point. We must also say that Messrs. Hick, Hargreaves & Co. are perfectly correct in bringing up marine practice in large engines in respect of shaft sizes. The shaft stresses in a marine engine are much greater than in a traction engine. In marine practice, in heavy weather, the load varies from zero to a maximum with a suddenness equal to anything in traction work. The truth is, that far too much is, and has been, made of the stresses in traction work, and we would refer our readers to an article in another column, dealing with this point at some length. This supposed enormous engine stress has been worked for all it is worth in electric traction by American contractors. It may be perfectly true that the Americans have made their engines for traction work very much heavier than those they had been accustomed to construct, but we doubt whether American traction engines are so particularly substantial and strong as Messrs. Allis would have people believe. We very much doubt if they compare in strength with engines sent out by Messrs. Hick, Hargreaves & Co. to some of the Indian mills, engines very much larger than these Glasgow engines, and very considerably over what is necessary for 2,500 KW. The idea that American engines are so very heavy and substantial is quite a myth. Let us look about us at a few American engines in tramway work in such places as Stoke, Cork, Dudley, and Dublin. At Stoke there are some McIntosh & Seymour engines. They are not particularly substantial, according to our English ideas. At Dudley, some engines by another maker, Ball & Wood, have a distinctly light appearance, and like other American engines, lack the finish and neatness of English work. At Cork, another type of McIntosh and Seymour engine may be seen. Is it 200 or is 500 the number of joints and pins of that most fearful assemblage of valve gear? But, except for this, we do not think the engines can be called badly designed in respect of excessive weight, though, probably, the valve gear might be lightened a ton or two. At Dublin may be seen a vertical McIntosh and Seymour engine at the old Balls Pond station, and some fairly large Allis engines at the new station in course of erection at Ringsend. But surely Messrs. Allis do not wish to claim for these Ringsend engines any substantiality over English work! Messrs. Hick, Hargreaves & Co. wrote a perfectly courteous letter to the *Manchester Courier* and other papers, which we reproduced last week, and they did not sneer at their American rivals. The Allis Co. wrote in very questionable taste indeed, and endeavoured to imply inexperience and ignorance on the part of Messrs. Hick, Hargreaves and Co. It is a claim put forward by the Allis Co. that the valves of their engines are often placed by them in the heads of the cylinder to the great reduction of waste space. This is a good arrangement for horizontal engines if properly carried out, but it is not a monopoly, and is of very doubtful value in a vertical engine.

But to return to the specifications. Alternative designs were called for, the one with two, the other with one low pressure cylinder. It is usual, in asking prices for alternative schemes, to place the more desired plan first. We believe that, acting under this impression, the English firm tendered for the three-crank engines. If we are correctly informed, the American tender for the apparently secondary two-crank engine scheme appears to have been the one accepted. This is a point which may have arisen from Mr. Parshall's ignorance of custom, but it is one which, on the face of it, certainly calls for explanation. The Corporation of Glasgow are not noted for their courtesy in their dealings, but it passes all bounds that they should have invited Messrs. Hick, Hargreaves & Co. to meet them at a special interview to discuss tenders and then have refused to discuss the question of their tender. Mr. Parshall owes an explanation of this. He was advising the Corporation, and unless he can explain it, this extremely discourteous conduct will also be laid to his charge. It is admitted that Messrs. Hick, Hargreaves tendered for an engine of satisfactory weight. This disposes of the Allis Co.'s claim of special substance. It differed in detail, and it ought to have differed in detail from the Allis engine if this was so designed as Mr. Parshall's figures would appear to prove. Then the English tender was £20,000 less than Allis's, which disposes of their claim about competing at 3,000 miles distance. £20,000 is good pay for sending even a well-paid man round the world, while the carriage item from Milwaukee is probably less than what the Bolton firm would pay under the paralysing charges of the London and North-Western Railway.

The special features of the engines, such as the so-called emergency valves, are English in origin. The emergency valve is the knock-off motion of the factory engine, and there is nothing in the demands made that Messrs. Hick, Hargreaves & Co., or any other high-class engine maker, would not easily have filled. Even the boring out of crankshafts was first practised largely by the Bolton firm. In fact, throughout the specification there is nothing very abnormal, previous to the dimensions above referred to, which could not have been explained if it had been desired to afford explanation. What Mr. Parshall apparently wanted, and he might have plainly said so, was simply a vertical cross compound (two-cylinder) engine. It looks as if he made himself appear to want a three-crank engine, and having received a tender reluctantly decided to pay £20,000 more for the two-crank type. The engines he seemed to desire were of a type of which more have been made in Great Britain than in all the rest of the world put together. That they were to be used for traction work was a mere incident, unworthy of serious argument.

Taking into review the whole of the circumstances, it will probably be considered by many that there is strong evidence of a foregone conclusion. The Soho Works at Bolton may not be so large as the Milwaukee Works, but they are equal to making much larger engines than are required for those little 2,500-KW. sets. We know less of Messrs. Duncan, Stewart & Co., of Glasgow, who tendered at less than half the price accepted, but what we do know of that firm is to their credit. We have tested their engines and found them economical. The firm is well known as a rival of an eminent Manchester works in some departments of engineering, and is well able to carry out anything it may undertake, and to give good work even if its tender may appear low. The consulting engineer has practically specified for an ordinary Lancashire factory engine. The biggest cylinders in the primary alternative are 60 inches × 60 inches, the exact size, if we mistake not, of the single cylinder of the "Iron Duke," put down by Messrs. Hick, Hargreaves & Co. at Eagley Mill, near Bolton, about the year 1884. This engine has Corliss valves in the cylinder heads on Messrs. Hick, Hargreaves & Co.'s plan,

and resembles one half of the engine asked for by Mr. Parshall. He has stated that Messrs. Allis had guaranteed a lower steam consumption than any English firm. This statement, we believe, is not in accordance with fact. Messrs. Hick, Hargreaves & Co., says the *Engineer*, guaranteed 1½ lbs. less than the Allis people.

So much in disagreement with the methods of Mr. Parshall, and of Glasgow. On the other side, putting aside any thought of undue partiality, the Allis Company may properly complain, if they can do so courteously, that they have not been fairly treated. They gave in, it is said, a shorter time for completion than any English firm. This is something. But there is a doubt whether they would, or could, have kept to time, and we find that the penalty clause is usually not enforced. There are always some extenuating circumstances. We hear that American contractors are by no means so punctual in delivery as a few specially reported cases—*e.g.*, the Atbara Bridge—have led people to believe. There is quite considerable delay in delivery of American machinery, and we cannot think that the difference in time was so serious as to warrant the rejection of the English tender. It appears that the Allis Company accepted the dimensions of Mr. Parshall *in toto*; it would be interesting to know how he arrived at them. But this does not prove the Allis designs to be good. They are not considered good by firms fully their equal in experience. Given only as suggestions, and put *outside the specification in order not to hamper contractors*, the non-acceptance of Mr. Parshall's dimensions is counted against Messrs. Hick, Hargreaves & Co. for sin. While, therefore, the Allis Company may feel aggrieved, they must have known there would be an outcry against such shabby treatment as was meted out to Messrs. Hick, Hargreaves & Co. by the Committee in refusing to discuss their tender after specially inviting them to be present for that purpose. After all, when a committee travels widely with a view to inspect foreign tramways, and learns so little as to require to pay an outside fee of £10,000, much surprise need not be felt at any blundering they may be guilty of, for, look at the matter as one will, Glasgow has blundered. Its Tramway Committee has blundered headlong into this traction business. They have their own employés fully competent to have dealt with the matter, and they must have been fully alive to the fact that if they employed an American consulting engineer, he was extremely likely to be partial to America. In a case like this of Glasgow, the step was entirely unnecessary. We say nothing of the electrical plant at present, as the case may be less strong in this respect, but in the matter of large steam engines we do say that no American firm has yet produced better steam engines than are turned out in our English shops. As regards finish, the English engine is far better. In material generally, the English engine is fully abreast of its rival, while in the wearing quality of the cylinders, we possess an undoubted and considerable superiority. As regards finish, however, it is probable that neither in England nor America is it equal to that of some of the work done in Switzerland. Whatever may be the final outcome of this Glasgow business, we hope it may draw special attention to the great amount of work to be done in electrical traction. Our English firms are many of them very remiss in pushing work. We have called attention to the excessively disagreeable tone of the Allis Company's letter, but this is as nothing compared with one shown to us a few days ago from a firm of electrical contractors to large users of electrical plant. The tone of this was downright insolent. Busy engineers are very little better than members of the A.S.E. in their callous disregard of the feelings of their customers, and we are not surprised that insulted customers should sometimes go elsewhere. Because the Bolton firm in their correspondence show evidence of a now too rare courtesy and refinement, in marked contrast to the quips and sneers of their American rival, we all the more regret their unfair and churlish treatment at the hands of the Glasgow Committee.

We have read somewhere the usual sneer that, after all, Englishmen are not free traders. But this is not a question of free trade. A gift of £20,000 is to be made to a foreign firm for an article in no way superior to the home production.

There is no feeling against American goods in England, as s well known. We are content to take them on their merits in fair competition, and to welcome them. But this Glasgow business goes altogether beyond the fair limits of competition. Lest it be thought we have made too much of what we deem the faulty designs of Mr. Parshall, we would observe that in the three-crank engine the crank pins are respectively 12 inches, 16 inches, and 20 inches diameter, and between these cranks come shaft bearings of 22 and 24 inches, while beyond the third crank pin the shaft suddenly jumps up to 32 inches diameter, a size altogether out of the way in respect of torsion, and unnecessarily heavy for a wheel of only 98 tons (220,000 lbs.). There is to be a 32-inch bearing on each side of this 98-ton wheel. We may conclude that the space occupied by the fly-wheel is small. The wheel carries no ropes or belts, and only needs to be wide enough to give the weight. Probably its bearings are not a yard apart. A dozen years ago a 72-ton fly-wheel 30 feet diameter placed on a shaft 12 feet long from centre to centre of bearings was allowed a shaft 19 inches diameter at the bearings and 24 inches diameter under the wheel. This was ample; it allowed a bearing intensity considerably below 130 lbs. of the projected area of the bearings. In one bearing of the proposed Glasgow engine the bearing figure is as low as 52 lbs. If the shaft should be very strong anywhere in a traction engine it is between the wheel and the generator. If a 32-inch shaft neck is required to carry the work of the engine increased, say, to double stress beyond the fly-wheel, how big a shaft is needed for torsion between fly-wheel and engine? Obviously if both shafts are bored out with a 12-inch hole the diameter would be 26 inches, which would have been ample in place of the 32 inches. Then, again, if a piston rod of 10 inches diameter is ample for a 60-inch low pressure cylinder, how does Mr. Parshall justify the same diameter for a rod of equal length on a cylinder of over double the area? As regards the Allis Company's remarks on the 100-tons fly-wheel and its bearings, it matters nothing to what duty an engine is put; this cannot affect the bearing pressure on the journals in direct driving, and the sneers at Messrs. Hick, Hargreaves & Co. on this point are quite unnecessary. The figures given look like misproportions, and if they do represent the best American practice, then so much the worse for it. They do not meet with the approval of engineers on the Clyde, and, after all, and despite the disclaimer as to marine practice made by the American company, something may be conceded to men who have engined a *Lucania*.

Since this article was in print the matter has been again considered by the Tramway Committee; the result of their deliberations may be seen in our "Notes" columns.

THE LABOUR CLAUSE QUESTION.

It may, perhaps, be thought that we have harped upon this string somewhat frequently during recent months. Our excuse must be that we are painfully impressed with the very serious consequences which municipal labour clauses must have upon the electrical engineering industry of this country unless a strong braking influence is speedily brought to bear upon the policy of labour interference.

The extent to which this intermeddling is carried on was shown very clearly in the statements contained in a Parliamentary return issued some months ago and published in abstracted form in the Electrical Review for *May 19th*, 1899. The data there collected may be re-studied with great profit at the present moment. Recognising at that date how general the practice was becoming, we stated that manufacturers would be compelled to offer combined resistance to it. Although, for certain reasons, one or two firms stood outside the combination, those who came to an understanding formed a very solid square, with the satisfactory results already recorded in the cases of West Ham and Sheffield electrical contracts.

But these are only two out of hundreds of Councils which may be expected to cause trouble within the next few years, considering that the great extension of electrical development is proceeding concurrently with the extension of the dictatorial policy. It is pretty certain that there are stormy times ahead for employers who determine not to submit to trade union interference as practised by local authorities.

We hope, nevertheless, that they will stand firm, and insist upon the rights of capital being not only recognised but respected.

It seems to point to something rotten in the electoral system of this country, that an intolerable system of trade union wire-pulling should control the placing of nearly all municipal contracts. The fact is, that rational people are few and far between on local government bodies. The rights of the working man, whose rates are very low, are too often considered at the expense of the large ratepayer. But this part of the question is too political to enter into at length here, particularly as it is hopeless to look for any immediate improvement in the *personnel* of our Councils. It seems that the quality of the article supplied, efficiency, price, and delivery are of less consequence to the municipal member than the insertion of clauses to determine what wages the contractor shall pay his employés, and to impose onerous and unnecessary conditions as to hours of work and the manner of conducting the factory. We say unnecessary conditions because there is no such thing as sweating existing in the electrical engineering trades, and, generally speaking, the wages of workmen are excellent for the class of work performed. Were there no disorganising combination of the trade union class, employers would, we believe, be able to look after the best interests of their workmen by giving them freer chances of promotion than is possible under the restrictive *régime* of union management.

We fail to see what legal right local authorities possess to dabble in trade unionism at all. It seems out of their province altogether. If a council wants certain apparatus supplied, so long as it gets a good thing at a fair price it should have no power to interfere with the wages that are paid or the hours that are worked, unless there is clear evidence that sweating is carried on at the particular works in question. A higher contract price is an obvious corollary of the imposition of restrictive conditions. Additional outlay, trouble, and anxiety must be paid for somehow, and all contractors, in sending in estimates, will take good care that there is sufficient margin allowed for it. Therefore a municipal body not only pays for the actual goods supplied, or the work done, but it pays the contractor a sort of gratuity to fall in with its whims and fancies as to labour employment. We are tempted to ask whether the Local Government Board quite appreciates the position in which it is placed by this state of affairs. This body is very ready to come down upon local authorities when an extra £10 or £100 has been spent in an irregular way, but the matter under consideration at the moment seems to us to call far louder for redress. The Local Government Board holds its inquiries regarding proposals to raise monies for certain public works. In the course of the hearing it transpires that a contract is to be given to So-and-so at, say, £10,000. There is no question raised as to what percentage of this sum is included by the tenderer as insurance against the probable effects of labour clauses. It is a point that might be raised with considerable advantage, and we think it would be a revelation to the ratepayers, who may be filled with the most sympathetic regard for the working classes, until they have it brought home to them that the public pocket is drawn upon somewhat deeply. They might then be also awakened to the fact that what they are paying for is nothing other than a meddlesome interference with private enterprise. We believe if the British public knew what costly extravagance these clauses are bound to engender, the principle of trades unionism would not receive anything like the support which is now given to it. In this respect the matter is one of general interest, and we are surprised that the leading daily papers have not devoted more attention to it. It is a gross misappropriation of public monies, calling for some action on the part of Parliament.

But from the standpoint of the employer the position is even more serious than from that of public morality. If he accepts the conditions, he is handicapped in securing the best output from his works, and is left at the mercy of his employés, for if they like to lodge a fanciful complaint an inquiry must be held by the Council as to its accuracy. In a large works this might lead to a dozen or more inquiries at one and the same time, so that the poor employer would be for ever involved in disputes which would do nobody any good, and in view of the municipal partiality for the workman might lead to the cancelling of the order after it had been three parts finished.

When so much is being written and said about masters being old fashioned or too orthodox, it ought to be borne in mind that they have been to an enormous extent hindered in their operations by the hysterical cries of a party which has been too much pandered to of late. How far the labour problem has been responsible for their slowness in adopting heterodox methods would be difficult to define to a nicety.

When the great engineering strike came to a close, conditions of management were mutually agreed upon between the Federated Engineering Employers and the Allied Trades Unions. The general principle of freedom to employers in the management of their works was approved as follows :—

The federated employers, while disavowing any intention of interfering with the proper functions of trade unions, will admit no interference with the management of their business, and reserve to themselves the right to introduce into any federated workshop, at the option of the employer concerned, any condition of labour under which any members of the trade unions here represented were working at the commencement of the dispute in any of the workshops of the federated employers; but, in the event of any trade union desiring to raise any question arising therefrom, a meeting can be arranged by application to the secretary of the Employers' Local Association to discuss the matter.

Nothing in the foregoing shall be construed as applying to the normal hours of work, or to general rises and falls of wages, or to rates of remuneration.

This clause introduced no new condition of labour. It simply provided for equality of treatment between the Unions and the Federation by reserving for all the members of all the trade unions, as well as for all the federated employers, the same liberty which many trade unionists and many employers had always had. Special provision was made in the clause and in the subsequent "Provisions for avoiding future Disputes," to secure to workmen, or their representatives, the right of bringing forward for discussion any grievance, or supposed grievance.

It is a fact, however, that some municipal authorities are attempting to go behind this decision in the clauses which they are endeavouring to get inserted into engineering contracts to-day. Let us take the case of Sheffield. The "fair contracts" clause which the Council wished to impose upon Messrs. Ferranti was as follows :—

THE ORIGINAL CLAUSE.

The contractor will be required by the contract to agree that all workmen employed in carrying out the contract in the City of Sheffield shall be paid not less than the standard rate of wages recognised by trade societies in Sheffield in each branch of trade represented in executing the contract, and to observe the recognised hours and proper conditions of labour. And for all work prepared outside the City of Sheffield and to be used in the city the minimum standard rate of wages paid by trade societies where such work is prepared, and if there be no such standard of wages in such place, then the contractor will be required to adopt and pay the Sheffield rate of wages and abide by the other conditions, as if such work had been executed in Sheffield. The contract will prescribe as the liquidated damages to be paid by the contractor, in case of breach of that condition as to wages, a sum of money equal to three times the amount by which the actual rate of wages paid by him at any period during the execution of the contract for any particular class of work is below the minimum standard rate of wages ruling in Sheffield and district for the same class of work during that period. These conditions shall also apply to sub-contractors.

THE CLAUSE AS AGREED TO.

That all workmen employed in carrying out the contract shall be paid at a rate of wages and observe the hours and conditions of labour as recognised by the Masters' Federation and the representatives of the Men's Trades Unions for the Oldham District. These conditions shall also apply to sub-contractors.

The contractors further agree that the engineer for the Corporation shall at all reasonable times during the progress of the works, have free access to the workmen of the contractors, and to the wage books of the contractors, and to the factories or other places which shall for the time being be in the occupation of the contractors for the purpose of this contract, and shall on behalf of the Corporation, be entitled to make full inquiry with the object of ascertaining that the stipulations in respect of rates of wages, and the conditions of labour, are being duly observed by the contractors.

Messrs. Ferranti objected to the clause in its original form because it was in no sense a "fair wages" clause, and because it would put the contractor working under it into an exceptional position, differing from that generally existing in the engineering trade. The firm is working its shops on

exactly the same lines as the rest of the engineers of the country as agreed upon between the Federation and the Unions as mentioned above. The firm proceeded to re-draft the clause so that it should comply with that agreement, and from the parallel columns arrangement on the previous page will be seen the difference between the suggested and the accepted terms. In one of their letters to the Council, Messrs. Ferranti wrote as follows:—

> We objected to this clause, because, as a matter of fact, there is no such thing as a standard rate of wages which applies to all men of a class in any district. We fully admit that there is a standard rate of wages which applies to some of the men, that is, to the fully qualified men in their respective trades, and it is these rates which are called the standard rates of the district. At the same time, we must point out to you that it is the general custom of engineers to employ very various grades of men for doing the same classes of work, and to pay them lesser amounts in wages than the so-called standard rates, where the full amount of skill is not required for the work they are expected to do.
>
> We have been into this matter very carefully with the Employers' Federation, and we find that we are in practice doing what is common amongst the various members of the trade, and what is, in fact, recognised by all the shops where trades unionists are daily at work.

It is to be deeply deplored that after a settlement had been arrived at in January, 1898, between the employers and the trades unions, the Sheffield Council or any other Council should use its influence to subvert that arrangement. It is quite in keeping, however, with the dishonourable and high-handed action which has characterised most of the dealings of the trade union party.

The extent to which the labour party is wrapped up in its so-called "fair" clauses is evident from a remark in a Sheffield paper:—

> The electric light undertaking had far better go slow for another winter, if need be, rather than lead the Council into a reversal of its labour policy, while it tamely holds the candle for an organisation which is trying to undermine trade unionism.

It is but a short step further to say "we will place the order abroad." Of course, if this sort of thing were carried far the employés would find that they were working out their own damnation. And we wonder if in giving contracts abroad the Councils make, or would make, the least inquiry as to the conditions of workmen in foreign factories!

We note, by the way, that at Sheffield the local branch of the A.S.E. pledged itself to give its best "moral and financial" support to the labour councillors and the Trade Council in their endeavours to bring about a reversal of the committee's decision to submit to Messrs. Ferranti's terms. Presumably the A.S.E. never intended to adhere to the 1898 agreement with the Employers' Federation!

When the Council met to discuss the question, the rejection of the committee's minutes was moved in a very lengthy speech by Mr. Hobson, who referred to the breakdown of the West Ham labour clause, and quoted from the ELECTRICAL REVIEW'S comments upon that matter, and our forecast as to the determined stand which the Federation intended to make. He said that what was being done in regard to the Sheffield contract fitted in exactly with our prediction of May last. West Ham had left the fight to Sheffield; was Sheffield going to allow the employers to have their own way? And much more of this in the same vein fell from Mr. Hobson's lips. He failed to appreciate that the determination of the contractors rendered it a case of Hobson's choice! The amendment was rejected by 26 votes to 23.

By this decision Messrs. Ferranti are at liberty to apply the principle of paying wages according to merit to every branch engaged on the work, and sub-contractors may do likewise. This is nothing more than the 1898 settlement, to which we hope and believe the employers will stand firm.

The urgency with which this particular plant was required for the Sheffield electric lighting installation was, we suppose, a point in Mr. Ferranti's favour, as any delay in placing the contract would prevent the supply of the works keeping pace with the demand.

We have dwelt at some length upon this subject because, as we have said, it is one pregnant with the most serious consequences to our national industries. We trust that there will be the most solid unanimity on the part of all engineering employers, and that in due course, by gaining here a little and there a little, the true position of affairs may be better realised by the public, and the employers will reap the reasonable and just reward for their struggles. To bring this about we should rejoice to see the matter taken in hand by the writers of the leading daily journals, for it is really a national question. In that way, and with the wise local co-operation of borough engineers and electrical engineers, and electric lighting committees, the present suicidal policy of trade unionism may be effectually abolished.

REVIEW.

Journal of the Institution of Electrical Engineers. No. 141. London: E. & F. N. Spon, 125, Strand.

The general contents of this number are as follows:—Continuation of discussion on Messrs. W. Duddell and E. W. Marchant's paper on "Experiments on Alternate Current Arcs by Aid of Oscillographs." Paper by Mr. J. Elton-Young on "Capacity Measurements of Long Submarine Cables." Paper by Mr. P. V. McMahon on "Electric Locomotives in Practice, and Tractive Resistance in Tunnels, with Notes on Electric Locomotive Design."

Abstract of a paper read before the Students' Section by Mr. W. G. Royal-Dawson on "Alternating Currents of Very High Frequency." Abstract of a paper read before the Students' Section by Messrs. M. R. Gardner and R. P. Howgrave-Graham on "The Synchronising of Alternators." "Obituary Notices."

LIABILITY FOR STREET ACCIDENTS.

In a case which was recently heard in the Court of Appeal, a question relating to the liability of a contractor for a street accident came before the Court for consideration. The excavation of the highway, which is so often a necessary part of the contractor's duty, is not infrequently attended with injury to the wayfaring public. In view of the number of foremen and sub-contractors which are often employed, questions relating to the liability of the original contractor sometimes assume considerable importance.

The laying of an electric cable or the establishment of a system of electric tramways involves the delegation of special work to the care of a sub-contractor, who selects his own workmen. What, then, is the liability of the head contractor for accidents which arise, whether by reason of the negligence of a foreman or not, in a department over which he has no direct personal control?

It will be seen that in the solution of this question we need not enter upon a discussion as to the liability of a master for accidents to his servants. Our sole object is to consider the liability of those whose actions are the cause of direct or indirect injury to the public, and whose responsibility is to be determined upon principles of common law unfettered by the existence of any contractual relationship between the parties. And this question is of no mean importance to the head contractor, for the injured party will generally seek to draw water from the deepest well by proceeding against the most substantial person.

Where work which, if properly conducted, can occasion no risk of injury to others, is placed in the hands of a builder or contractor, who selects his own workmen and servants for the performance of the work and directs the manner of doing it, it may be taken as a general rule that such contractor, and not the person who employs him, is the person responsible for injuries to strangers from the negligent execution of the work. Such is the state of the law in cases where evil consequences need not necessarily follow. But where a man orders work to be executed, lawful in itself, but from which, in the natural course of things, injurious consequences to others must be expected to arise, unless means are adopted by which such consequences may be prevented, he cannot relieve himself of his responsibility by employing someone else to do what is necessary to prevent the act he has ordered to be done from becoming wrongful.

In Black *v.* the Christchurch Finance Company, Limited, (1894) A.C. 48, which was heard in the Privy Council, the

law upon the subject was fully discussed, if not finally settled, by the members of the Court. The plaintiff there sued the defendant company for damage occasioned by fire which had arisen on their land and had spread to the plaintiff's part of the bush. It was pleaded by the defendants that the mischief had been done by their contractor. It was held that the defendant company were liable in damages for the act of their contractor in negligently and improperly lighting a fire on their land, and permitting it to spread to the plaintiff's lands; even though such contractor in so doing, disregarded special stipulations contained in such contract relative to the time at which such fire would be lit.

The same principle was laid down in Hardaker *v.* the Idle District Council (1896) 1 Q.B. 335. In that case the defendant council, being about to construct a sewer under their statutory powers, employed a contractor to construct it for them. In consequence of his negligence in carrying out the work, a gas main was broken, and the gas escaped from it into the house in which the plaintiffs (a husband and wife) resided, and an explosion took place, by which the wife was injured, and the furniture was damaged. In an action by the plaintiffs against the district council and the contractor, it was decided that the council owed a duty to the public so to construct the sewer as not to injure the gas main; that they had been guilty of a breach of this duty; that, notwithstanding they had delegated the performance of the duty to the contractor, they were responsible to the plaintiffs for the breach; and that the damages were not too remote to be recovered.

In the case which forms the subject matter of this article, the facts were as follows:—The National Telephone Company were lawfully laying down wires along the pavement in Clapham. In order to make the connections at the joints, they left the trench open at those points along the lines of piping where the joints were to be made. George Highmore, a plumber, was employed for this work, which was to be done "to the satisfaction of the foreman in charge of the work for the sum of 12s. per connection, bends included. While Highmore was doing the work he found it necessary to plunge a benzoline lamp into a ladle of molten metal. It was proved that the safety valve on the lamp was out of order. The lamp exploded and injured the plaintiff, who now brought his action against the National Telephone Company. It was proved that a servant of the company was assisting George Highmore when the accident happened. It was contended by the defendant company that Highmore was an independent contractor, and that they were not liable for his negligence, which was not part of, but collateral, to the work which he had been employed to do. It was held by the Court, which consisted of the Lord Chancellor, A. L. Smith, and Vaughan Williams, L.J.J., that the defendants were liable. The Lord Chancellor said, "In my opinion the defendants, who authorised these works to be done, whether they delegated the execution of them to another person or not, were under an obligation to protect passers-by from injury arising from the execution of their works."

It will be seen from the above decision that the liability of the National Telephone Company extends to a very wide limit. Had the accident happened owing to the negligence of someone in their own direct employ, no question would have arisen, and this case proves that they cannot delegate their responsibility to a sub-contractor.

SMOKE PREVENTION IN BERLIN.

At present Berlin has no Smoke Act, but has been considering the question, a committee having been appointed in 1892. But Paris in the meantime has drawn up smoke prevention rules, and this has stirred up Berlin, and now it is announced that after January 1st, 1900, all black smoke will be forbidden. Thus has another "verboden" been added to the already formidable list. Being legally and properly verboden, the committee thoroughly believe that there will be no more black smoke.

It will cease suddenly at 12 midnight next December 31st. Efficient devices are believed to be obtainable, and no hardships are going to be inflicted by the rule on any proprietor of a sooty chimney. During a discussion on a paper read on the subject in Berlin, it appeared, however, that smoke was not looked on by all as so great an evil. Was not London one of the healthiest of cities? We expect that the Berlin committee will be wiser and sadder men before another year has elapsed. We read of a new form of forced draught grate not much different from one described by Mr. Foley in his paper at Newcastle before the Institution of Naval Architects, which employs hollow bars perforated on the top, and fed with air by a blower. It is said that excellent results have been obtained by this bar in the way of smokeless combustion. One man deliberately states, says the *Trades Journals' Review*, that the appliance has reduced his coal cost by three-fourths. We know what this means. It may represent sound practice, but it may equally represent merely a change of fuel. We have known where a much cheaper fuel has been used by some patented apparatus, and reduced costs enormously, but after all, the cheaper fuel would have shown even better results with the original apparatus. It was by such means as this that the Hopcraft furnace was floated, great stress being laid on the reduction of one-half the fuel cost in a particular case. We happen to know the boiler, and found it was simply a case where Welsh coal had been used, whereas the cheaper fuel used by the new furnace could just as well have been used all along. The ways of patent furnace men are so wonderful, that we have become sceptical of all appliances until we have actually seen them for ourselves under a combustion rate of 18 to 20 lbs. About 12 lbs. per square foot of grate per hour seems to be a favourite rate with patent furnaces.

THEORETICAL v. PRACTICAL EFFICIENCY.

By SYDNEY F. WALKER.

The development of the electric lighting industry, and still more, that of its big brother, the use of electric currents for power purposes, renders the question of efficiency more and more important. Every fraction of 1 per cent. efficiency that the engineer can obtain in any part of his apparatus is something saved in cost. But the writer believes that in very many instances the use of the term is really misunderstood, and that engineers and committees often specify, and insist on obtaining from manufacturers, a so-called efficiency which takes from, instead of adding to, the real practical efficiency.

Let us consider first what is meant by efficiency. At once we are met by the fact, well known to the engineer who has to study the commercial side as well as the engineering side of the problem, that there are two efficiencies. Every engineering problem consists in the transformation of some form of energy, which is inconvenient for the purpose in hand, into some other form which is convenient; and the final transformation is usually only obtained after a series of intermediate transformations. One kind of efficiency, therefore, is:—The proportion of energy we obtain in the final form in which we use it, of that which is present in our initial source. In the case of the ordinary electric lighting station, for instance, we have, as our initial source of energy, the heat generated by the combustion of the coal, oil, refuse, or other combustible we use in our furnaces, or the energy present in the water, wind, or other natural source of power, that we use to move our turbines, &c. The useful energy in its final form is the sum of the energy present in the light rays furnished by the arc or incandescent lamps on the service. The efficiency of transformation is the proportion which this latter bears to the energy utilised at the source, and, as engineers know, this is very small. But there is another kind of efficiency, more important even than the efficiency of transformation, and which may be termed the commercial efficiency, viz, the proportion which the cost of the article supplied, the

electrical energy, bears to the price obtainable for it. The price obtainable for any article, even for electric lighting currents, is ruled by conditions over which usually the maker has no control whatever. When sold for lighting purposes the current has to compete with other means of illumination, and though the price obtained is in many cases higher than the cost of some of the rival illuminants, it is still ruled by how much extra the consumer can afford to pay for the increased convenience, increased safety, &c., and is still beyond the control of the supplier. The two forms of efficiency naturally work together over a large portion of the cycle of their operations; but, in the writer's opinion, there are many points at which, by an ill-judged extension of the efficiency of transformation, the commercial efficiency is lowered. One point that at once occurs to one is that of the cost of apparatus. In the commercial efficiency the interest on the capital expenditure is a most important factor. In efficiency of transformation it has no bearing at all. Now it may easily, and often does happen that in his efforts to obtain an extra 1 per cent. or 2 per cent. efficiency in any particular part of the plant, the engineer has added more to the interest on capital than he has taken off the bill for coal and other incidentals. On the other hand, by an unwise economy in certain other portions of the plant, the engineer may again be losing more on his station by current unaccounted for than he has gained in interest by the saving in cost. Again, it very frequently happens that an increase in the efficiency of tranformation is obtained by cutting everything very fine in construction, by "sailing very close to the wind," as sailors express it, with the result that very trifling extra strains, such as are unavoidable in practical work, cause a breakdown of the apparatus, a stoppage of whatever portion of the work it was performing, and a cost many times in excess of the saving due to the extra efficiency obtained.

Passing from the general question to details. If a natural source of power exists, such as water or wind, it may be economical, and therefore commercially efficient, to make use of it, notwithstanding the fact that a very large quantity of water may be used to perform the work that would be done by the combustion of a very small quantity of coal or oil. Yet, again, if, as often happens, the supply of water is uncertain, so that steam plant must be kept as a reserve, or if the cost of making reservoirs, laying pipe lines, &c., is above a certain figure, the interest may be so great as to neutralise even the full advantage of obtaining the source of energy for nothing. Again, coming to engines and boilers, the higher the pressure to which steam is raised the smaller is the proportionate quantity of coal or other combustible necessary to be consumed in the furnace, but this advantage is more than lost unless a large portion of the expansive force of the steam can be utilised. And here, again, the conditions of commercial efficiency and that of transformation do not always agree. For an ocean-going steamer there can be no possible mistake. Steam can be raised to the utmost pressure the appliances will warrant, and that can be economically utilised by means of triple and quadruple expansion engines; but the central station engineer who made use of the same engines would be most unwise, as he would add very largely to his coal bill. *En passant*, a very striking instance of the difference between real or commercial efficiency, and that of transformation, is the case of the tramp steamer. The economical speed for these ships is the low figure of 8 knots. Passing on again to the matter of engines and boilers, Welsh coal is by far the most efficient in the world, considered from the view of transformation, while town refuse is probably one of the lowest on the scale of combustibles; yet if the town refuse can be delivered and consumed, as in many cases it can, at a cost to the town less than that previously incurred in disposing of it, or even at a slightly higher cost, it evidently becomes more efficient in the commercial sense than the best coal, or other combustible which has to be paid for. The limit is reached, of course, when the extra cost of dealing with the refuse, including interest on special refuse plant, exceeds the cost of the coal for which it is substituted. Again, after the gases formed by combustion in your furnaces have done all they can in raising steam, there is still a good deal of energy remaining in them; and after the steam raised in the boiler has done all it can in driving the engines, there is still a considerable quantity of untransformed energy remaining in it. Every heat unit that can be extracted from either the gases or the steam after they have passed through their respective apparatus, is so much added to the commercial efficiency, provided that the cost of working the energy saving plant, and the interest on the capital outly, does not exceed the value of the units recovered. So, again, high speed engines which can be coupled directly to dynamos are necessarily more efficient, the combined plant, than slow speed with belt or rope driving. As they also take less floor space, their use may have an important bearing on the commercial efficiency where the land upon which the station stands is valuable, as in the centre of large towns; yet, if the use of these engines demands the presence and the time of highly skilled attendants, the commercial efficiency may possibly be lowered, rather than raised by their use. But perhaps the apparatus upon which the engineer is most tempted to proceed to extremes, in his striving after efficiency of transformation, is the dynamo and the motor. Electrical engineering is in a more advanced state, notwithstanding its so recent development, than any other branch of engineering in the sense that electrical engineers have more complete command of their work than any others. The electrical engineer who understands his work can design a dynamo or a motor for any efficiency he pleases within certain limits. It is no more trouble for him to design for 95 per cent. than for 85 per cent. His troubles commence, of course, when the cost is gone into, and it is then that he is often tempted to increase his transformation efficiency by certain measures, which in very many instances seriously affect the commercial efficiency. To take one frequent case that is often met with—transformation efficiency requires that the space occupied by air insulation and active conductors between the iron core of the armature of a dynamo or motor and the iron faces of the field poles should be as small as possible, and so the engineer is tempted to make his insulation thin radially, and the clearance between the external periphery of his armature and the polar faces very small. Sometimes Providence is kind, and the machine works all right for some time, but more frequently some trifling expansion, due to the passage of an increased current, or to some other cause, takes place, and the conductors rub on the polar face, and the machine has to stop for the time. The designer would say, of course, that the increased current, or the increased expansion from, say, another source of heat, ought not to have taken place. Experience, unfortunately, proves that it always does, or nearly always. Or if the machine escapes this fate, it will, if the insulation has been cut fine, probably fall a victim to the property the electric current has of throwing a spark across between two conductors through all kinds of intervening material when temporarily possessed of several times its normal E.M.F., as when induction takes place.

What then should be the course of the engineer who wishes his plant to be efficient commercially, as well as in the transformation sense? The answer, in the writer's opinion, is, CALCULATE! CALCULATE! CALCULATE! Calculate each item in the cycle of transformations from every point of view. Watch the loss in each transformation, and watch the cost of reducing it. One golden rule may be taken. *Nothing is so commercially efficient as continuous running.* Whether you are furnishing lights for streets, shops, &c., current for hauling tramcars, for pumping, or cutting coal, or whether you are running a cotton mill, driving a steamer across the ocean, the one thing that you can always be quite certain will pay, is continuous running; and while every possible improvement, every possible source of economy should be carefully considered and carefully tested, nothing should be adopted which admits of even the remote probability of stoppage. A striking instance in point comes from America. An electrical engineer in the States was asked to advise a man who had 100 sewing machines working as to driving them by electric motors. The question was, should one 10-H.P. motor be put in to drive the lot, 10 motors of 1-H.P. to drive groups of 10, or a motor to each machine. After the question had been explained to him, the proprietor himself decided for a motor to each machine. As he put it—if one motor of 100 goes wrong, it means one girl idle; if the one motor which drives the lot goes wrong, it means complete stoppage. In the writer's opinion, the proprietor was quite right, provided the $\frac{1}{10}$-H.P. motors were as reliable in work as the larger ones.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 305.)

Bonding.

In the early days of electric traction the earth was assumed, in accordance with telegraph practice, to be devoid of resistance, and was therefore selected to form the return circuit to the generating station. It was not long, however, before the excessive fall of pressure at the end of the line observed in working, and involving serious loss of power, was correctly attributed to the great and varying resistance possessed by the earth return. In addition to the loss of power involved, the currents which found their way back through the earth to the generating station, in seeking the path of least resistance, passed through all the metallic conduits which lay in proximity to their course, and caused most serious damage therein by setting up electrolytic action. Gaspipes, waterpipes, hydraulic mains, telephone and telegraph cable conduits were subject to most mischievous and serious deterioration, and traction companies had to make this damage good at ruinous expense. The careful investigation of the subsoil conditions led to the recognition of the following facts:—

1. That salts of ammonia, potash and soda, and carbonates of calcium and magnesium of a soluble character were always more or less present in the ground.
2. That a mere directive force in the nature of difference of pressure was sufficient to cause a current to flow.
3. That the presence of a small amount of soluble salt was sufficient to set up electrolysis, which continued as long as a current flowed.
4. That the amount of current depended upon the relative resistance of the soil and the pressure causing the current to flow.
5. That the corrosion due to electrolysis depended on the amount of current flowing from a given area and the nature of the salts present, the order of activity being chlorates, nitrates, and sulphates.
6. That there is no actual transference of iron from the anode to the cathode, this being deposited in the soil as hydroxide of iron.

From the above it was apparent that with continuous currents electrolytic action must always occur wherever a sensible difference of potential existed in the return circuit, whether that was wholly or partially composed of the earth, or so long as any of the currents found their way back to the generating station through the earth. With alternating currents the whole of these difficulties would disappear, but so long as continuous currents are used for electric traction purposes, the question of the return circuit must remain of primary importance.

Were it not for the question of cost, the difficulty involved in setting up electrolysis in surrounding metallic conduits could be met by placing them in metallic connection with the rails, so as to keep them at a uniform potential, but this would seriously interfere with the telephone and telegraph services using earth returns, by inducing heavy currents in their cables.

An ideal return circuit would evidently be an insulated copper wire of no less capacity than the feeder, with which connection could be made at every instant as freely as with the feeder, but this again is out of the question on account of the cost.

On the whole, the only reasonable alternative seems to be the utilising of the rails as the return circuit, insulating them as far as possible and improving their joint connections so that the conductivity should be uniform, or, in other words, that the joints should be abolished electrically and the drop throughout the return circuit should not exceed the restricted limits of loss due to the specific resistance of the rails. This involves the whole question of bonding and bonds, the latter being daily more and more recognised as among the most indispensable accessories of electric traction.

The specific resistance of steel rails of the ordinary composition, *i.e.*, with the high percentage of carbon now usual for railway and tramway purposes, at the ordinary atmospheric temperatures, is from 10 to 11 times as great as that of copper; but the cross section of the rails in common use for tramway purposes is from 200 to 300 times the area of the feeders, so that the conductive capacity of the rails, irrespective of the joints and insulation, as compared with the feeders, is from 20 to 30 times as great as would be theoretically necessary. It is evident that with bonds joining their ends giving approximately a conductivity equivalent to that of the rails themselves, the drop in potential due to leakage at the points of contact between rails and their supports and the rails and the earth could be reduced to a negligible amount in excess of the loss due to the specific resistance of the steel composing them. In other words, a return circuit of a uniform specific resistance equivalent to that of the rails between joints, would present such an easy channel for the return current that practically none would find its way to the generating station through earth, and the electrolytic action set up in the neighbouring pipes and mains by stray currents would be insignificant, while the drop in potential or the loss of power in the circuit through leakage, would approximate to the irreducible minimum involved in the molecular changes set up in the material of the rails, by the passage of the current. The question, therefore, of the more or less loss of power in a circuit and the production or non-production of damage to the pipes and mains existing in the neighbouring subsoil, resolves itself into the question of the effective electrical bonding of the rails.

The conductivity of a joint evidently depends upon both bonds and fishplates. That the latter, even when the rails have been in use for some time, have an appreciable effect on conductivity has been conclusively shown by Mr. H. F. Parshall in a recent paper before the Institution of Electrical Engineers. Both by laboratory tests and tests on rails in actual use with bonds and without bonds, Mr. Parshall shows that the resistance at the joint with the fishplates removed was more than double that of the combined fishplate and bond, and that the conductivity which the fishplate contributed to the joint did not sensibly deteriorate with age, the contact between rail and fishplate being preserved fairly well, even when not fully tight through the bright patches always existing on both surfaces. On the whole, the resistance at a joint increases inversely with the tightness of the fishplates and the cleanness of the contact between them and the rails, and that independently of the character of the additional bond used for the joint. Mr. Parshall expresses the resistance of the joint in terms of the equivalent rail length added to the general resistance of the return circuit by the joint,

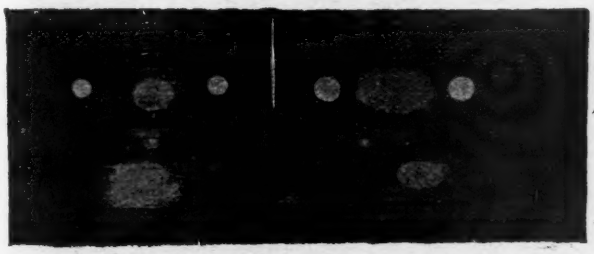


Fig. 79A.

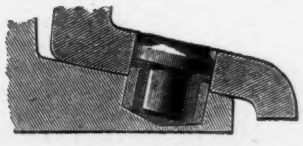


Fig. 79B.

and this seems to be a particularly happy way of expressing the matter.

There are three ways in which the ends of rails may be bonded electrically:—

1. By utilising their usual fastenings.
2. By adding bonds independent of these fastenings.
3. By dispensing with the usual fastenings and substituting a special joint or doing away with the joints altogether.

The first method involved the utilising of the ordinary fishplates with the addition of a plastic metallic composition to form a bond between them and the rails.

The only form of bond of this character which is in use is known as the Edison-Brown plastic rail bond (fig. 79A). In this bond the contact between the rail and the fishplate is established by a special metallic plastic composition inserted between the web and the fishplate, after contact spots about 2 inches in diameter have been cleared of scale and rust and treated with a solid alloy which instantly silvers the surfaces and prevents rusting. The plastic composition is held in a 1½-inch hole in an elastic cork case treated on the surface with a sticky compound, and these cases are placed in position as near the end of the rail as possible. The conductivity of the completed joint is practically equal to that of the fishplate. Some plastic bonds which have been in use for five years have shown no sensible deterioration, the explanation being that, when correctly applied, these bonds never rust.

The plastic bond is also applied (fig. 79B) in a somewhat different manner, when used for rebonding old T and girder rails, with fishplates having angle projections over the rail foot. At the end of each rail a hole is drilled diagonally through the angle plates, and into, but not through, the base of the rail. These holes may be of any suitable diameter from $\frac{5}{8}$ inch upwards. The drill used for boring these holes is made with a specially obtuse angle, so that as it penetrates the lower surface of the plate, it carries down a burr into the surface of the rail. A part of this burr is forced between the rusted surfaces between the fishplate and the rail, and forms a telescope hole perfectly smooth on the inside. To avoid the surface being lubricated with a non-conducting substance, a solution of soda and water is used instead of oil in drilling, and the drill chips are removed with a permanent magnet. The holes are then amalgamated with the solid alloy, and partly filled with the plastic compound. An amalgamated copper plug of T shape is driven into the hole dipping into the plastic alloy, and is locked in place by a burr made with a blunt chisel. Mr. Parshall's experiments before alluded to, with 1½-inch plastic bonds and 83-lb. rails, demonstrated that the resistance of the joint expressed in inches of rail, which, with one plate only bonded, and no contact between rail and plate, except through the bonds, amounted to 24 inches of rail; by double bonding could be reduced to 14 inches, and by allowing free contact between rail and plates, to 9 inches only, the bonds being apparently responsible individually for $\frac{5}{24}$ths of the total resistance each, the contacts between fishplate and rail collectively to about the same amount as one bond, the balance being divided between the four bolts and the resistance induced by the "gathering" of the current at the bond terminals and in the neighbourhood of other points of contact between the rails and the fishplates, and amounting to about $\frac{9}{24}$ths or $\frac{3}{8}$ths of the total joint resistance. To make these plastic bonds as efficient as possible, it appears to be necessary to connect both fishplates with the rails, and to keep the fishplates in as close contact with rails as possible, or, in other words, to screw up the bolts as tightly as possible, and use some form of lock-nut that is not liable to working loose under service conditions.

The category of added bonds, independent of ordinary fastenings, comprises what might be called bonds proper, and here the ingenuity of inventors has been lavishly expended in scheming devices of infinite variety of form to meet the requirements of the case. They, however, all belong to two groups, viz:—

(A) Long and uncovered bonds;
(B) Short and covered bonds;

Group A being bonds external to the fishplates, and Group B bonds that are placed between the fishplates and the rails. These groups are each of them sub-divided into four classes according to the character of the contact established between the rails and the bonds, viz.:—*a*, mechanical contact; *b*, soldered contact; *c*, welded contact; *d*, amalgamated contact. The phenomenon termed "gathering of current," which occurs in the neighbourhood of the joints in a conducting circuit, seems to be analogous to the retardation induced in the flow of water through pipes by bends or contracted orifices, and is no doubt produced by the same causes, viz., the increased friction or resistance due to the contraction of the effective sectional area of the channel through which the flow is taking place. Successful bonding, therefore, means the limitation of "current gathering" at rail ends to the irreducible minimum involved in the flow of a current across the physical boundary or gap existing between one conductor and another. In the case of mechanical contact this gap is filled by a film of air occluded between the contiguous surfaces of rail and bond. In the case of soldered and welded contacts the gap is filled by the film of soldering or welding material, and in the case of amalgamated contact by a film of amalgam, and in all three of these latter cases by some portions of occluded air films in addition. The resistance of the gap may be further increased by the presence of a film of dirt or oxide on the surfaces. The following conditions have obviously to be observed in all bonds to ensure successful results:—

1. The sectional area of the bonds and of the rails they unite must be sensibly in the relative proportion of the conductive capacity of the metals composing them, *i.e.*, the effective areas of the channels offered to the flow of the current by rail and the bond respectively must be practically equal.

2. The contact surfaces must be as few as possible, and their areas as restricted as possible, subject to their being proportioned to the lesser conductive capacity of the two metals; *i.e.*, in the case of steel and copper, the area of the contact surface must be in proportion to the conductive capacity of the steel and not the copper, or from 10 and 11 times as great as would be necessary between copper and copper.

3. The gap between the contact surfaces must be as restricted as possible; *i.e.*, the surfaces must be brought as close together as possible.

4. The contact surfaces must be absolutely cleared of all dirt and oxides before the contacts are made, and kept clear thereafter.

If the above first condition is complied with, it is obvious that the bonds comprised in Group A must all be more costly than those comprised in Group B, which will inevitably replace them sooner or later, irrespective of the question of the relative merits of the designs.

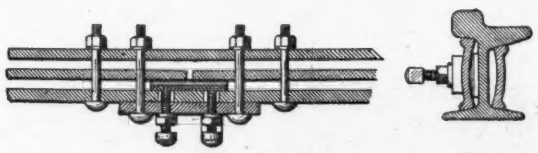


Fig. 80.—Ajax Bond.

In a similar way the constructive difficulties involved in the use of bonds composed of metals whose conductive capacity is inferior to copper must as inevitably be replaced by bonds made of the latter metal, if for no other reason than their relatively more bulky and unwieldy dimensions.

Condition 2 disqualifies all compound bonds, *i.e.*, those composed of more than one metal or of more than one piece on the score of the multiplication of contact surfaces and of the gaps between them. Condition 3 demands that the contact between the bond and the rail should be brought about by the application of considerable force in such a way that its effect shall persist, after the force is withdrawn, unaltered. Condition 4, in addition to the careful cleansing of the contact surfaces previous to bonding, also demands that they shall be treated as for Condition 3, so that the film of air imprisoned may be reduced to a minimum, and with it the chance of the future formation of a film of oxide between them similarly reduced.

This much being premised, it becomes possible to critically examine the details of the various leading bonds in use and determine their merits and defects.

Class *d*, or "amalgamated contact bonds," contains very few examples, the "Ajax bond" (fig. 80), belonging to Group B, being about the only one now used. It consists of a strip of copper placed under the fishplates and pressed against the rail ends by set screws working through the fishplates, the contact surfaces being amalgamated. The defects of this bond are:—(1) Complexity of parts and multiplication of gaps; (2) impossibility of maintaining gaps at a constant minimum interval; (3) disturbance of contacts when contraction or expansion of rails takes place, and consequent increase of resistance; (4) cost.

Class *b*, or "welded contact bonds," also contains very few known examples. The "Payne welded bond" (fig. 81) also

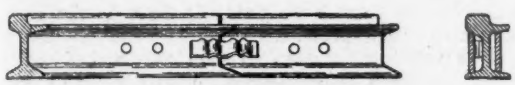


Fig. 81.—Payne Welded Bond.

belonging to Group B, consists of a corrugated strip of copper with flat terminals welded in any position on to the rail ends. The objections to this form of bond are:—(1) impossibility of obtaining a really perfect weld under the conditions of track-laid bonding; (2) the unavoidably increased resistance introduced by the residual film of spelter remaining between the welded surfaces; (3) increased cost involved in welding.

Of Class *c*, the only "soldered contact bond" which is at all used is the "Syracuse bond" (fig. 82). This is used

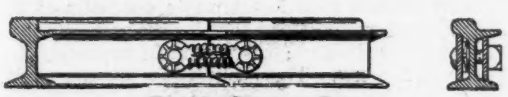


Fig. 82.—Syracuse Bond.

in forms belonging to both the long and short groups. This bond consists of broad flat terminals connected to wires by soldering, which are themselves soldered to the webs of the rails. The objections to this form of bond are due to its compound character and to the multiplicity of the gaps between its various parts; and also the relatively high cost of its application owing to the process of soldering involved.

(*To be continued.*)

CORRESPONDENCE.

The Glasgow Contract.

Such of your readers as are engaged in supplying local authorities with tenders for electrical or steam plant, will, I am sure, be ready to extend their sympathy to Messrs. E. P. Allis & Co. in this their hour of affliction. Although it has fallen to the lot of some of us to miss contracts at or near the bottom prices, our sorrow on these occasions has been tempered by considerations similar to those which consoled the fox when he failed to get the once coveted, but now despised, grapes. Whether our philosophy would have supported us if we had only just missed booking a top price, and such a top price as that before us, I hesitate to consider.

Permit me to suggest, for the comfort of Messrs. Allis, that, now they have come to do business in England, they must endeavour to realise that the municipal system, with all its virtues, is attended with certain inconveniences under which we all suffer. These inconveniences are known to the corporations as well as to engineers, but both are powerless to remove them.

There is not an engineer in England that has not had his brains picked and the details of his schemes published, not of malice or chicane, but of necessity, and he, recognising this fact, endeavours to possess his soul in patience.

Personally, I think Messrs. Allis made a tactical mistake in addressing their letter to the *Manchester Courier*, for Lancashire is a county of mechanics, who are just as cocksure that everything they turn out is the best that money can buy as are our American friends; and, further, they have learned by experience to render so much respect to the firm of Hick, Hargreaves & Co., and to have such confidence in all the products of Soho Foundry, that no amount of assertion would make them believe that any engine built therein could be either "inefficient, unreliable, or antiquated."

John S. Raworth.

August 30th, 1899.

THE CHARGING SYSTEM OF FIRING.

This method of firing was recently advocated in the columns of the *Practical Engineer*, and we have inquired further into the system, which we have always advocated as suited to forced draught working on the contention that fire thickness, draught, and fuel dimensions are more or less interdependent. The charging system cannot well be carried out when the rate of combustion exceeds 10 to 12 lbs. per square foot. At such rates it can be managed without difficulty, but even then some selection is required in the coal, which is best when it consists of a mixture of slack and moderately round coal. When this mixture is properly charged right along the centre of the grate, the rounder pieces tend to roll down the heap and towards the sides of the grate. The sides of the fire are thus more open than the middle, and the draught penetrates more freely, and when charging is properly done there is a belt of flame on each side of the fuel heap which curls round the furnace, and meets at the crown of the furnace. A fair natural draught of about ½ inch water gauge is necessary. As the whole heap cakes through, it is finally burned into holes, which need to be filled up, and when burned sufficiently low, the mass can be approximately levelled and recharged. With such a mass of fuel on the grate, and a reserve of draught, there is great command over the working of the boiler, and steam can be made readily. We believe that with forced draught this system has not been attempted, but we see no reason to doubt that a good stoker, who should be allowed to try the system for a time to acquire the practice necessary to a new system, would, with forced draught, secure similar results upon a heavier rate of fuel consumption. It must be clearly understood that there is no spreading of the coal upon the bars; only so much goes to the sides as rolls there by gravity, and an experienced man is able to so charge a furnace as to heap up the centre of the ridge to within a short distance of the furnace crown. It might be thought that in this system there would be a large volume of smoke produced, but this is not so. Such smoke as is produced comes off from the surface, and the whole volume of gases from the mass requires a long time to evolve, and, as it does come off, it does not come into contact with the furnace crowns, but finds itself in the narrow space between the fuel mound and the arch of flame which rises up from the sides of the grate.

In charging a fire on this system, the stoker commences against the bridge and fills up this end first, the mound sloping gradually towards the firedoor. A longitudinal section of the fire would show a line parallel some distance with the furnace crown and then sloping downwards to the dead plate in a curve, convex upwards. Similarly, a cross section would show an approximately parabolic, or haycock, form. Such a form enables the condition of the whole length of furnace to be seen from the furnace door, and is also favourable to the proper admixture of any necessary fresh or auxiliary air, the admission of which may be in smaller volume and of greater duration than when small charges of fuel are made upon a bright thin fire. In such case the hydro-carbon gases are at once liberated in great volume, and a short period of very copious air admission is necessary. As said above, with ordinary chimney draught the system cannot very well be used with a rate of combustion above 10 or 12 lbs. per square foot of grate per hour.

Mr. Ingham, a Manchester engineer of great experience in steam boiler work, rightly says, however, that with forced draught almost everything can be done, but he lays stress on

some amount of selection being necessary as regards the coal—that it should have a proportion of round coal which will roll to the sides as charged and secure the action aimed at—the flame belts round the furnace plates.

The principle underlying the method is the preservation in the furnace of a large mass of fuel ready to be quickly put into a condition of more rapid combustion as soon as a demand is made for more steam. But the method demands what is technically known as boiler room, and as we have already pointed out, where double the fire-grate area could be arranged with a given heating surface, it would appear desirable to do this or to secure the same end by means of fan-assisted draught. The tendency of late has been to claim unduly high possibilities for steam boilers. It is likely that more moderate figures will be worked to in the future.

Probably some of the excessive smoke of electric light stations is due to the too heavy work demanded from steam boilers. Where anything over 20 lbs. of coal per square foot of grate area per hour is to be consumed a fan draught will be required, and with a fan draught and bituminous coal there must be provision to bring the fan pressure to the auxiliary air ducts, for the blast pressure will prevent any fresh air being admitted at the furnace doors, and such auxiliary air must be forced into the furnace.

LONG DISTANCE TRANSMISSIONS FOR ELECTRIC RAILWAYS.*

There seems to be no doubt that in the near future long distance transmissions by means of polyphase currents will form an important feature of electric railway practice. A number of instances of this practice have already been mentioned in the *Review*, and a new road has just been projected in the Kootenay country of British Columbia which will be operated by means of a power plant which contains a number of most interesting and unique features. It should also be added that this is but one of a considerable number of polyphase transmissions in the Pacific North-west, where there has lately been remarkable activity in the projection and construction of long-distance transmissions operated by water-power. While for the purpose of supplying power for general purposes, and especially to mining machinery, the induction motor has now become a worthy rival of direct current machinery, street railways will undoubtedly continue to be operated from sub-stations containing rotary transformers for the production of 500-volt direct currents.

The West Kootenay Power and Light Company, whose plant is described in detail in the *Journal of Electricity* of May, 1899, contains an unusual number of useful and instructive features. This plant is essentially a power plant, only a small percentage of its output being applied to lighting purposes, and so various are the uses to which this power has been applied and with such eminently satisfactory results that a considerable extension of the service is to be made, including an electric railway, which is to be installed at once.

The engineering features of this plant are most interesting. The power house is situated on the Kootenay River, which forms a connecting link between Kootenay Lake and Columbia River, and the Bonnington Falls, from which the power is supplied, are situated near the lower end of this river. At low water these falls, both upper and lower, are capable of delivering 267,000 H.P., but the lower falls, a part of which the West Kootenay Company has utilised, have an available head of 40 feet at low water, and are capable of delivering 100,000 H.P.

The company constructed a canal cut out of hard rock, 650 feet in length, and 26 feet wide, the lower end of which widens out into a forebay 54 feet wide. The forebay is shut in by a dam of solid concrete, 32 feet high and 26 feet wide at the bottom, tapering to 6 feet wide on top. Across the head-race, 250 feet from the concrete dam, is a wooden dam sloping at an angle of 42°, constructed of sills and timbers securely fastened between the two high bluffs. This dam is 44 feet high, and has five sluiceways across the bottom, the object of which is to control the supply of water to the forebay at all times.

The back of the dam really forms one side of the power house, and of the tail-race, which runs at right angles to it, being a pit 20 feet wide by 30 feet deep, and extending nearly the length of the power house, which is 66 feet. The dam is provided with two feeders of 9 feet each, and one of 10 feet, the upper ends of which are closed with wooden gates. Two outside frames extend upward of 30 feet, and the racks for raising and lowering the gates are bolted to the wall of each pit. The gates are each provided with a small iron flood-gate, and the main gates are raised and lowered by means of head-gate irons bolted to the top of the dam. The winch controlling these is operated by one man. Three steel penstocks run through the dam into the hydraulic room of the station, each penstock carrying a standpipe nearly as high as the top of the dam. To the lower end of each penstock is bolted a housing which contains a pair of 39-inch horizontal cylinder gate turbines, the housing being supported on I-beams laid on the retaining walls of the tail-race. The draft tubes 22 feet long and 10 feet in diameter are bolted to the bottom of the housings. The generators are coupled direct to the turbine shafts, and three exciters are driven by three independent 12-inch horizontal gate turbines contained in cast-iron flumes connected to the housings of the large wheels, from which they derive their water supply.

The dynamo room contains two 750-KW. generators and one of 1,500-KW., all of the standard General Electric revolving field type. These run at a speed of 180 revolutions per minute, have 40 poles and deliver three-phase currents at 1,100 volts.

The transformer room is a separate compartment at one end of the dynamo room, and contains the necessary capacity of air-blast transformers; they are 12 in number, each of a capacity of 250 KW. These deliver at a pressure of 20,100 volts to the line. The pole line is a double line extending to Rossland, a distance of 31 miles, the profile of which varies in height by over 2,200 feet, and a step-down transformer station is situated at the latter town. A branch is taken off the main line at a point three miles from Rossland which runs to Trail, B.C., a distance of four miles. At this town is situated the great smelter of the Canadian Pacific Railroad, and a transformer station at this point provides three-phase currents at 550 volts for the operation of various parts of the smelter. At this point an electric tramway is to be immediately built, the operation of the plant in all kinds of weather having been so successful as to encourage the company to extend its operation to railway work.

* *Street Railway Review.*

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—The creditors of Lawrence John Lawrence, electrical engineer, 5, Stafford Street, Old Bond Street, W., met on Thursday at the London Bankruptcy Court. The debtor commenced business about four years ago without capital. Six months later he was joined in partnership by Mr. W. H. Butcher, who introduced £200 capital, and the style of the business was altered to Lawrence & Butcher. That partnership was continued for about a year when it was dissolved by mutual consent, Mr. Butcher taking £120 in cash and the debtor retaining the stock and book debts. All the partnership liabilities were settled and the dissolution was duly gazetted. The debtor continued the business by himself up to last Christmas. In December, negotiations were entered into for the formation of the business into a limited company with a capital of £2,000, but nothing came of them, and the matter is at present the subject of litigation. Accounts filed under the failure show unsecured debts £334 8s. 7d., and assets, doubtful book debts, £50. The reasons given for the failure are bad debts, illness, loss in business, and insufficiency of capital. No offer being submitted the creditors left the matter in the hands of the Official Receiver to be wound up in the usual course of bankruptcy. The public examination is appointed for September 19th. Appended is a list of the principal creditors, viz.:—Unsecured.—General Electric Company, Limited, £81 12s. 8d.; W. McGeoch & Co., £42 8s. 11d.; Paterson & Cooper, £38 3s. 8d.; John Russell & Co., Limited, £20 2s. 3d.; H. M. Salmony & Co., Limited, £33 17s. 7d.; and various sums under £20. Partly secured.—H. J. Lawrence (security valued at £70), £100. Preferential creditor for rent, £37 10s.

A receiving order has been made in the case of H. W. Thane, electrical and general engineer, The Hill, Northfleet, Kent, on debtor's own petition. The first meeting is to be held at 115, High Street, Rochester, on September 6th, and the public examination will take place at Court House, Eastgate, Rochester, on September 4th.

Electrical Wares Exported.

Week ending Aug 30th, 1898.		Week ending Aug. 29th, 1899.	
Aden. Teleg. cable	Value £33,600	Adelaide	Value £108
Amsterdam	900	„ Teleg. mat.	70
Auckland	40	Alexandria. Teleg. mat. ..	60
Barcelona	18	„ Teleg. wire ..	28
Bombay	88	Amsterdam	160
Boulogne	99	Bangkok	17
Cape Town	156	Boca. Teleg. mat.	970
Colombo	24	Bombay	72
Durban	181	Boulogne	40
„ Teleg mat.	166	Buenos Ayres	18
Flushing	70	„ Teleg. mat. ..	375
Fremantle	1,089	Calcutta	498
Graymouth	39	Cape Town	151
Hamburg	100	Channel Islands	558
Hobart	15	East London	384
Malta	86	Fremantle	90
Melbourne	57	Flushing	20
Penang	17	Gothenburg. Teleg. wire ..	36
Port Elizabeth	514	Hamburg. Teleg. mat. ..	100
Port Said	25	Hong Kong	69
Rangoon	50	Iquique	85
Shanghai	57	Lyttelton	35
Sydney	671	Melbourne	75
Trieste. Teleg. cable	654	„ Teleg. mat.	830
Yokohama	29	New York	29
		Port Elizabeth	19
		Rotterdam	11
		Shanghai	40
		Singapore	1,806
		St. Petersburg. Teleg. wire ..	59
		Stockholm. Teleg. wire ..	19
		Sydney	218
		„ Teleg. mat.	775
		„ Teleg. wire	872
		Toronto	120
		Wellington	21
		Wiborg	45
		Yokohama	978
Total ..	£38,703	Total ..	£9,141

Book Received.—"The Electrical Engineer's Central Station Directory." Third edition. Biggs & Son, London. 3s. 6d.

Catalogue.—The new complete catalogue just issued by Messrs. Veritys, Limited, belongs to that class of trade publications which one keeps along with directories and the other works essential in a commercial establishment, so as to be always ready to hand for reference. The catalogue being a complete collection of all the classes of electrical machinery and wares in which Messrs. Veritys do business is necessarily bulky, but it is so neat and unobtrusive in its binding, &c, that it will be quite in keeping with the most elaborately furnished offices. It is complete in nine sections, which we mention in outline: (*p*) plant and machinery; (*m*) motors and motor driving (from which we published a selection of illustrations showing motor applications some weeks ago); (*w*) wires, cables, and wiremen's sundries; (*a*) switchboards and accessories; (*b*) bells and telephones; (*s*) surgical and medical appliances; (*e*) electric light fittings; (*d*) ship, mine and dock fittings; (*g*) reflectors, glass and silk shades. In addition to a host of illustrative and descriptive matter, we notice several interesting features, viz.—Estimates for complete private plants; comparative costs of gas and electric light; hints on house wiring and joint making with wiring rules and tables; metric measurement tables; electric bell and telephone connection diagrams. The electrolier, standard and statuette fittings section has a special glazed paper which shows the illustrations up to best advantage. Some of the designs are very pleasing.

The Chitty Dynamo and Motor Company, Limited.—The senior Official Receiver, Mr. G. S. Barnes, has issued a summary of the statement of affairs on the date of the winding up (June 26th, 1899) as submitted by the directors, together with his observations thereupon. The gross liabilities are put at £32,556, expected to rank £32,342. The amount estimated as available to meet unsecured creditors (subject to cost of liquidation) is £20,912 13s. 9d, and there is thus an estimated deficiency of assets to meet the liabilities of the company, of £11,429 10s. 10d. There is no unpaid capital liable to be called up to meet the above deficiency. The capital issued is £33,030, and adding to this the deficiency above stated, there is a total deficiency of £44,459 10s. 10d. The chief cause of the failure appears to be the insufficiency of working capital. The company went to allotment on December 18th, 1897, upon a total cash subscription of £5,540. The purchase price was originally fixed at £56,000 without any valuation by Mr. Chitty and his solicitor (£11,000 cash and £45,000 in shares), but in consequence of insufficiency of cash capital, these terms were modified, and it was arranged that Mr. Chitty should be paid £28,000 (£1,500 cash and £26,500 shares), and the remaining £28,000 to be payable in proportion to a further issue of capital. Mr. Chitty was to be appointed for five years as managing director at £1,000 a year, but for the first year only £500 was paid, the deficiency to be made up in the following year by cash or shares. The expenses of carrying on the business have been £1,955 plus directors' fees, £160, salary to managing director (cash and shares) £1,530, ditto claimed to end of agreement £3,4:9, depreciation in plant, &c., £897, depreciation in letters patent £36,000. The gross receipts have been £19 15s. 9d. A dynamo motor has been supplied at £40 14s., but £10 odd has to be spent upon this before it will be in working order and payment obtained. Mr. Chitty and the other directors have valued the letters patent at £20,000, but, says the receiver, it is doubtful whether any such amount will be realised unless some scheme is formulated for working the patents. The liquidation of the company has been left in the hands of the Official Receiver with a committee of inspection.

Directory.—The "Universal Directory of Railway Officials," for 1899, has now been published from the offices of the *Railway Engineer*, 8, Catherine Street, Strand. This directory contains very useful information regarding railway officials all the world over. It is divided into sections dealing with England and Wales, Europe, Asia, Africa, Australasia, North America, South America, but there is also an alphabetical index for ready reference comprising every name included in the other sections.

Dobson & Curtis v. Weldon.—At Dublin Courts (Chancery Division) last week, this action was brought by Messrs. Dobson & Curtis, Limited, electrical engineers, Stephen's Green, Dublin, against Mr. Joseph V. Weldon, Rathgar Road, for £47 11s. 11d. for goods supplied and work done.—Defendant's counsel applied that the action be remitted to the Recorder of Dublin sitting at Kilmainham, and the Court made the order.

Electrical Progress in Germany.—From the official statistics just issued by the German Electrical Bureau in Berlin for the year March 1st, 1898, and March 1st, 1899, we learn that the increase of electrical works, &c., in the German Empire during that period has been unprecedented. For whereas in the preceding period the number was 96, it was at the end of last year 105, and it is calculated that in the current year or so the number will be increased by no less than 123 new works more. In these figures are not included installations for the working of tram and railways, or private concerns. All these works have been started since 1880, indeed, the Great Berlin Electrical Works are only 15 years old. These figures speak eloquently enough, but the figures compared with the gas statistics are still more pointed. For whereas the first gasworks in Germany were started in 1825, there are now only 816 such works, *i.e.*, in the period of 75 years the gasworks only outnumber the electrical by about 300, whilst the latter have only a history of 20 years. Indeed, it is estimated that in another four years the number of both will be equal. As regards agency of working it may be of interest to mention that three-fifths of the electrical works are driven by steam engines, and one-tenth by water turbines. The largest electrical concern in Germany is the Rheinfeld Transmission Works in Baden, capable of developing 12,000 KW., the central station in Hamburg coming next with 7,000 KW. The Berlin Electricity Works have three stations, developing respectively 1,700, 5,500, and 5,000 KW., whilst the works at Frankfort-on-the-Main produce 4,200 KW. All other works develop no less than 4,000 KW. Coming to the lighting statistics we learn that whereas in 1894 all glow lamps in Germany only numbered 500,000, they now number 2,000,000 in round figures, whilst the number of arc lamps have increased in that period from 12,500 to 41,500. The motors in working at present represent nearly 70,000 HP. As regards the future progress of electricity in Germany there is still a wide field of operation open, as although all the seven cities with a population over 350,000 have now electrical works, and all those with a population under half a million will be similarly provided at the end of the year, and only eight towns with a population below 100,000 will then still be without such, there remains nearly 3,000 towns with a population below 50,000 which possess no electrical works.

The Institution of Junior Engineers.—The summer meeting of this Institution has just taken place, the rendezvous being Portsmouth, with excursions to Southampton. There was a larger attendance than usual, being about 12 per cent. of the total membership. The party reached Portsmouth on Friday, August 11th. Among the works of interest visited was the Portsmouth Corporation Electricity Works, and it was very evident that the undertaking, under the superintendence of Mr. E. Price, was in a healthy condition. New plant was being laid down to meet the increasing demand for current. The accounts for the year ended March 31st last, showed a credit balance on revenue of £9,650. The total maximum supply demanded was 1,132 KW.; there were 261 public lamps, and the total quantity sold had been 1,224,949 units. The Southampton electricity works were also visited. The Summer Dinner was held at Portsmouth, Mr. B. H. Joy presiding.

Liquidations, Dissolutions, &c.—The Porcelain Electrical Fittings Company is to be wound up voluntarily, Mr. T. W. Hayes, Cheapside, Hanley, Staffs., being appointed liquidator.

Mr. A. Shuttleworth was in July appointed liquidator for the winding-up of Browett, Lindley & Co., Limited, now reconstructed.

Creditors of Galloways, Limited (the old company now liquidating for reconstruction), must send particulars of debts, &c., to Mr. J. W. Pollitt, 7, Pall Mall, Manchester, the liquidator, by October 7th.

Messrs. H. G. Massingham and G. N. C. Mann (Massingham and Mann, electrical engineers, Torquay) have dissolved partnership. Mr. Massingham attends to debts.

The *London Gazette* records that on August 10th a committee of inspection was appointed to act with the official receiver and liquidator of the Chitty Dynamo and Motor Company. Messrs. E. E. Barrow, A. C. Bean, and D. J. Edmonds, were appointed on the committee.

Rope v. Central London Railway.—At the Sheriff's Court on the 24th ult., Mr. Under-Sheriff Burchell and a special jury, had under consideration an action for compensation brought against defendants by Messrs. John, James, and Walter Frederick Rope, refreshment contractors, carrying on business in the Bayswater Road. The claimants, as we gather from a report in the *City Press*, had cause to make serious complaints as early as 1896, shortly after the new line was begun, about the effect of the works upon their premises and since then the damage and inconvenience had been considerable. The tunnel ran beneath the pavement, and

the oscillation caused by the work was felt continuously day and night. The property had suffered to a considerable extent, and damages were consequently sought. On behalf of the railway company several expert mining engineers were called, and expressed an emphatic opinion that the damage complained of by the claimants could not possibly have resulted from the work in operation in connection with the construction of the line. They attributed the cracks in the walls, and other damage to the age of the building, the clay surrounding the foundations, and certain recent structural alterations. The jury found that the damage had not been caused by the railway works, and gave a verdict for the defendants.

Tower Wagons.—The well-known Heathman ladders have been in use for some time at Dublin, Swansea, Prescot, and Newcastle-under-Lyme, and Messrs. Heathman & Co. are now building tower wagons for Carlisle and Sunderland. They are considered to be specially suitable for electric trolley wire construction and repair work.

Trade Announcements.—Mr. Felix Chapman, of Birmingham, has been appointed sole agent for that city and district for the British Electric Works Company's parts and fittings.

Messrs. Donnison, Burton & Co., electrical engineers of Llandudno, have opened a branch at Bangor.

Mr. Walter Gray, electrician, has just opened premises at 342, Fulham Road, S.W., as St. Mark's Metal Company.

Messrs. Sax, Slatter & Co., Limited, have removed from Foresters' Hall, Clerkenwell, E.C., to 1, Basil Street, Sloane Street, S.W.

Messrs. Laing, Wharton & Down, Limited, announce that in consequence of the rapid development of their export business, and the necessity for dealing with it in a systematic way, they have arranged with Messrs. Fry & Co., Limited, 18, Billiter Buildings, London, E.C., to attend to this department, as their special knowledge of this kind of business will enable them to deal with it to the best advantage. All correspondence relative to export business, addressed to Messrs. Fry & Co., Limited, will have prompt attention.

ELECTRIC LIGHTING NOTES.

Aberdeen.—Tenders for electrical supplies for the current year have been opened in committee and remitted to Mr. Bell, the electrical engineer, for tabulation and report.

Asylum Lighting.—The plans for the proposed electric light installation at Rainhill Asylum have been approved by the Lancashire Asylums Board. Subject to the Secretary of State's approval, £24,000 has been granted for the work.

Aycliffe.—Messrs. Cox-Walker, of Darlington, have reported to the Parish Council on the water-power available for electric lighting, and a resident, Dr. Lambert, has offered to present a dynamo to the village.

Ayr.—A letter from Mr. Hammond was before the Town Council last week in the minutes of the Lighting Committee with reference to the decision of that body to accept the proposal to exchange one of the present low speed plants for a high speed plant. Mr. Hammond asked Messrs. Siemens to quote their lowest price for the 200-kw. set and their tender was £2,880 (for a Siemens-Belliss steam alternator similar to the two recently supplied to the Ayr Corporation). Mr. Hammond asked the E.C.C. and Messrs. Fowlers to quote for a 200-kw. set, to comply with the high speed plant specification. Messrs. J. Fowler & Co. quoted £2,765 and the E.C.C. £2,575. The committee had advised the Council to settle with Messrs. Siemens on the terms quoted less £100.

Bath.—The "noisy" arc lamps led to another animated discussion at last week's meeting of the Electric Lighting Committee, a further report from Mr. Hammond as to the working of the lamps being read. It was again contended that the lamps worked without undue noise when the pressure of supply was fairly constant. Mr. Hammond recapitulated at length the steps which had been taken during the past month to place the lamps in satisfactory working order, pointing out that since the introduction of the choking coils there had been considerable improvement, the sound emitted being within the limits allowed for lamps working with alternating current. A report as to the week's test ended with the following paragraph:—"Taking the test as a whole, I am of the opinion that the carbons used by the works are quite good enough, and that the regulation of the pressure on the Brush machines should be controlled with much greater accuracy than at present." At the close of his report Mr. Hammond urged that the variation of the generating pressure was a matter over which the contractor had no control, and they could not be held responsible for any unsatisfactory results in the working of the lamps arising from the excessive variations which had been proved to take place. Under all the circumstances, he did not feel warranted in refusing any longer to grant a certificate to the contractors for the retention money, and in future he should recommend any members of the Committee who encountered unduly noisy lamps to make certain whether they were being run under proper conditions before placing the blame on the contractors or on the consulting engineer. Mr. Hammond said it also appeared, upon investigation, that it was the custom of Mr. Metzger to run the arc lamps in the small hours of the night with the Brush machines taken over from the old company, in connection with which the methods for regulating pressure were most primitive.

The chairman, Alderman Taylor, remarked that if they were compelled to believe all this report contained, it would place them in a very serious position indeed with their own engineer.

Mr. Metzger, the engineer at the works, replied in detail to the communication from Mr. Hammond. He said it was known to Mr. Hammond and the Electrical Construction Company that it was always intended to run the arc lamps off the Brush plant, but to satisfy the contractors they were run off their own machines at all tests, and at some risk to the new plant. The results always proved, in spite of what Mr. Clayden might report to the contrary, that the different machines made no difference to the humming of the lamps. Mr. Todd, Mr. Hammond's own representative, reported, as the result of special experiments on May 11th, that "a variation on the primary volts to the extent of 50 from the normal either way did not affect the noise given out by the lamps to any practical degree. As regards variation of speed, I am not of opinion that this makes any appreciable difference in the lamps beyond the fact that at the lower speed, and consequently lower periodicity, the test-room lamp seemed quieter." Mr. Hammond, writing in reference to this report of Mr. Todd, said: "For my own part, I believe the noise is due to the vibration of the working parts, and especially the core, and I cannot understand why they do not tackle the problem from this standpoint." Dealing with the report of Mr. Clayden, Mr. Metzger said it was a pity that Mr. Hammond did not observe the working of the lamps personally rather than rely altogether upon the opinions expressed by his subordinates. In his (Mr. Metzger's) opinion, the choking coils had effected a great improvement in the working of the lamps, and it only remained to be seen whether such improvement was permanent.

Mr. Shum moved a resolution to the effect that, while they could not adopt or agree with Mr. Hammond's report, they recommend the Council to pay the bill.

Mr. Shum's resolution was carried.

Mr. John then moved an additional resolution to the effect that the committee, having heard the reply of Mr. Metzger, express their entire satisfaction with their engineer's method of running the plant and general management of the station.

This was seconded by the chairman and carried unanimously.

Belfast.—The question of improving the lighting of the upper portion of North Street has been before the Police Committee, but, pending the report of the sub-committee as to the desirability of adopting electricity, action in the matter was deferred.

Brighouse.—The Council's electricity department for the year ended March 31st last, showed a loss of £205 18s. 3d. The price is to be increased from the same date 2d. per unit for lighting purposes, viz., from 5d. to 7d. per Board of Trade unit.

Bristol.—An architect is preparing plans, &c., for the further extension of the electricity works. Mr. Bell, the assistant engineer, has resigned his post, and the question of a new appointment rests with the Electrical Finance Sub-committee.

Cleethorpes.—The District Council has decided to engage Mr. A. S. Barnard as electrical expert, and the Hull Corporation is being asked to give its consent to the arrangement. The tramway company has informed the Council that plans and specifications for the power station are nearly ready.

Cobham.—The Epsom Rural District Council has been notified by the Cobham Gas Company of its intention to apply for a provisional order for electric lighting at Cobham. The Cobham Parish Council asks the Epsom body to strongly oppose the application. It is stated that the gas undertaking has been bought up by a syndicate, which intends to keep out a private electric lighting company if possible.

Coventry.—The quarterly report of the Electric Light Department, presented to the City Council on Tuesday, showed satisfactory progress. The amount of current supplied was 18,925 units, as compared with 14,178 in the corresponding quarter last year; rentals, £429 12s. 7d., as against £328 1s.; number of consumers, 147, an increase of 30.

The City Council has completed negotiations with the National Electric Free Wiring Company, for introducing its system of free house wiring.

Dover.—The Town Council will arrange for electrical illumination of the Granville Gardens and the Monument during British Association week.

Dyce.—Ratepayers were called together last week to pass a resolution forming Dyce into a special lighting district. Messrs. P. C. Middleton & Co., electrical engineers, have submitted a proposal to the Council, under which they would pay £50 per annum for spare water-power at the water works and supply electric lamps of 16 c.p. for public lighting at 25s. 6d. per annum, and for private lighting at 16s. to 25s. per light.

Epsom.—The Board of Trade has approved of the electricity supply scheme.

Fenton.—The Royal assent had been given to the Fenton Council's electric lighting order.

Godstone.—At a recent meeting of the District Council a letter was read from Edmundson's Electricity Corporation, Limited, in reference to their application for a provisional order for electric lighting in the parish of Warlingham. It was proposed to put a generating station down for the supply of both Caterham and Warlingham.

Fulham.—Messrs. Willans & Robinson, who are one of the sub-contractors under the General Electric Company, Limited, for the electrical contract for the Fulham Vestry, have offered resistance to the labour clause, which was made one of the conditions in their contract. The course matters have taken may be gathered from the following report, which we have reproduced from our exchange, the *Contract Journal*:—

"A special meeting of the Electric Lighting and Dust Destructor Committee of the Fulham Vestry has been held to consider communications from their consulting engineer, the General Electric Company, Limited, and their sub-contractors for engines, Messrs. Willans & Robinson, with regard to trade union rate of wages. The following letter was submitted from Mr. Medhurst, the engineer, who attended:—

Westminster Chambers, 13, Victoria Street, S.W.,
August 14th, 1899.

W. J. H. Denselow, Esq.,

Dear Sir,—I enclose herewith copy of letter received from the General Electric Company, Limited, from which you will see that Messrs. Willans & Robinson, the sub-contractors for some of the smaller engines in your electric lighting station, refuse to be bound by the terms of the contract in respect to the payment of trades union rate of wages. You will see from the General Electric Company's letter that Messrs. Willans & Robinson have prepared a full statement of the wages, &c., that they pay their workmen, and that these they are prepared to pay for work undertaken for your Vestry. I shall be glad if you will arrange for a committee meeting at an early date for the purpose of discussing this question.

Yours faithfully,
F. H. Medhurst.

"The General Electric Company wrote as follows:—

Peel Works, Adelphi, Salford,
August 9th, 1899.

To F. H. Medhurst, Esq.

Dear Sir,—We regret to inform you that Messrs. Willans & Robinson refuse to be bound to pay the union rate of wages, and we give you below extract from their letter: "We have no reason to fear a comparison of the rates we pay with those paid by any other firm in our district, but we must decline, and always have declined, to accept union rates, or anyone else's as a standard binding upon us. Under these circumstances, unless you get the clause withdrawn, we must ask you to place the order elsewhere. We enclose list showing the rate of wages paid here, which was prepared for the information of firms tendering to the Battersea Vestry, whose order for the engines, you may remember, has been placed with us. We are willing to accept any clause which falls in reasonably with the payment of these rates. We are, of course, very sorry that this opportunity for working with you should fall through, but the acceptance of this clause would be contrary to the principles to which we have definitely decided to adhere." Will you, therefore, please instruct us if you still wish us to place the order with Messrs. Willans & Robinson, whose rate of wages (copy of which we enclose) appear to favourably compare with the rates paid in their district, or whether we are to place the order elsewhere, in accordance with the rider embodied in Clause 39 (sub-letting, &c.). We may say that we have already prepared drawing of our dynamo coupled to Willans engine, but we are delaying sending this in for your approval until we learn your decision. Unless you decide that the clause can be altered or ignored in this particular instance, we should propose to supply Musgrave engines. Your kind and immediate attention will much oblige.

Yours faithfully (for the General Electric Company, Limited),
(Signed) Tom Hawkins.

"A list of rate of wages paid was subjoined. It was decided that the Committee saw no reason why Messrs. Musgrave & Co. should not have the contract for the exciter engines. This was agreed to."

Gloucester.—The applications which have already been received for the electric light are stated to be very satisfactory, and show that the installation will result in a clear profit.

Haslingdon.—The site originally proposed for electricity works is not considered suitable, and the Sub-committee has been recommended to look for a better one.

Hornchurch.—The Cottage Homes Visiting Committee of the Shoreditch Board of Guardians have considered the question of lighting the Cottage Homes at Hornchurch by electricity, at an estimated cost of £4,000. The Guardians generally are favourable to the scheme.

Ilford.—A Local Government Board inquiry has been held here *re* the Council's proposed loan of £4,400 for a site for electricity supply and tramway works.

Kensal Town.—The Kensal Town members of the Chelsea Vestry will bring before a special Vestry meeting, arranged for September 26th, a proposal to apply for a provisional order for electrically lighting their portion of the parish.

Larne.—The District Council has passed a resolution to the effect that a committee be appointed to consider the entire question of the lighting of the urban district, with power to obtain legal advice, and to consult experts.

London, E.C.—An explosion occurred in a Bartholomew Close electric light main box on Tuesday afternoon.

Lowestoft.—The Town Council last week further discussed the question of electric trams. It was proposed that "in consequence of the decision of Her Majesty's Light Railway Commissioners with regard to the non-construction of the light railway from Gorleston to Lowestoft, the Council is now released from its engagement to support the East Anglian Light Railway Company," and that it was advisable to take a municipal electrical scheme in hand, the Drake & Gorham Company to be informed accordingly. This was not carried, as the Mayor moved and it was resolved—

That in view of the guarantee by the Drake & Gorham Electric Power and Traction Company, Limited, to proceed in the next Session of Parliament to obtain powers under the Tramways Act to construct as a tramway the portions of the proposed light railway, for which they failed to obtain the sanction of the Light Railway Commissioners, and to substitute for the proposed route of Railway No. 6, an alternative route to be agreed to by the Council, this Council will continue its support to the scheme of the said company on certain conditions.

It was stated by the clerk "that the purport of the amendment was that the Corporation would postpone their application for powers until they saw how the company fared with their application."

Middlesbrough.—The Corporation has accepted tenders for building the works for the electricity station.

Newark.—Mr. Vesey Brown has been engaged to advise the Council on an electricity supply scheme for the town.

Newcastle-on-Tyne.—The Sanitary Committee of the Corporation has decided to appoint a Committee to consider the advisability of using the city refuse for the generation of steam. It has been thought that steam thus raised might be employed for generating electricity for the Tramways Committee's purposes.

Oldham.—The Borough Council has considered and approved the minutes of the Electric Lighting Committee, referred back by the previous meeting. The committee proposed to expend about £4,000 on a boiler house at Rhodes Bank, in order to meet the increasing calls for electric light, and to prepare for the demands which will be made upon them when the local tramways are municipalised, and converted from horse and steam to electric traction.

Perth.—Tenders for the electric light installation plant have been received from over 50 firms. They were to be considered on Tuesday.

Pontypool.—The Urban District Council is to approach the Electric Light and Power Company with the view of opening negotiations for the purchase of the company's works.

St. Helens.—A Local Government Board inquiry was held on the 29th ult. *re* the Corporation's proposed loan of £3,600 for electric lighting extensions. The town clerk gave particulars of previous loans raised for electric lighting, and said that in 1897 the Corporation purchased the local tramways and resolved to build a station for generating electricity on the continuous current system, both for lighting and traction purposes. A considerable demand for motors had sprung upon the town, and the Corporation now proposed to lay new continuous current mains and relay the old alternating current cables in the districts of Parr and Sutton, two new areas to be opened. The current to the new areas would be supplied on the alternating system from the Warrington Road works. The change of current would mean that the people now using electricity would have to change their lamps, and the Corporation proposed to bear the cost of such changes, as the consumers could not be expected to bear the expense. The town clerk added that the demand for electric lighting was steadily growing. Up to March in 1897 the number of 8-c.p. lights in use was 2,570; in 1898, 4,752; in 1899, and from March last to June last the number had increased to 6,714. The price for electricity up to June last was 6d. per unit, but it was now 4½d. per unit, while for power it was 3d. for three hours and 2d. afterwards. Besides the total amount of money borrowed under the Local Government Board authorities £25,000 had been obtained for tramways equipment and other purposes by permission of the Board of Trade. Mr. Highfield, the borough electrical engineer, then gave details of the scheme, and said that it would not be necessary to take up all the cables from the streets where they were already laid. They would take out only the high tension feeders. The plant for the new districts would be capable of supplying 3,500 lamps of 8 c.p. The Corporation had demands for 1,200 lamps. The inquiry then terminated.

St. Paul's Cathedral Lighting.—It is stated that a contract has been given to a West-end firm for the electric lighting work at the Cathedral, and a start has been made with fitting up the necessary tubes for carrying the wires.

Shoreditch.—The proposal of the Committee to spend £4,000 on the electric lighting of the Cottage Homes will not be acted upon by the Guardians until the report has been circulated among the members.

Southampton.—The borough engineer is to prepare plans for the Works Committee of the City Council of the proposed positions of the electric light and tramway pillars on the Shirley route.

Staines.—The General Purposes and Drainage Committee has had an interview with Mr. Offor, of the Electrical Power Distribution Company, Limited, with reference to the company's proposed application for a provisional order for the district. Mr. Offor will submit terms upon which an order could be worked.

Stirling.—The Burgh Buildings, King Street, are to be lighted electrically. The master of works is to submit a specification and estimate of the cost.

Sunderland.—On Tuesday a Local Government Board inquiry was held as to the proposed loan of £40,000 applied for by the Corporation for the extension of the electric lighting station and plant. The Corporation have already spent £71,000 over electrical plant, and a profit has been realised. In view of the electric tram scheme more plant is needed.

Swansea.—It is stated that the tenders received for electric lighting plant, &c., are higher than was anticipated, and they have been referred to the engineer to report upon.

Wales.—The Urban Council of Bala has rescinded a resolution to erect gas lamps in certain parts of the town, and will re-consider the whole question of lighting, electricity having been mentioned in connection with the matter.

Walker.—Application was made at the meeting of a committee of the Newcastle Corporation last week by the Walker authorities for the erection of a power station to generate electricity. The matter will be brought up at the next meeting.

West Ham.—In connection with our account of the electricity works last week, we omitted to mention that the installation of the electric light in all the public offices, amounting to nearly 1,000 lamps, was carried out by Mr. H. J. Rogers, A.I.E.E., of Watford.

Wigan.—The Corporation has applied to the Local Government Board for sanction to borrow £90,000 for electric lighting purposes. The erection of a dynamo house and other premises will be at once proceeded with.

Woodhall Spa.—There is a good deal of talk about an electric lighting scheme which is expected to take shape directly. Our local correspondent says that an engineer has been asked to send in an approximate price for putting down a lighting plant at the sewage works and carrying current into the town by overhead wires.

Wrexham.—The Local Government Board has requested the Council to furnish certain details regarding the electric lighting work, for which it wishes to borrow £2,000.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barcelona.—The chairman of the Barcelona Tramways Company, on Wednesday, told the shareholders that electric traction was inaugurated on their system in January last with the running of only nine electric cars. At the present time they had 78 electric cars and 42 mule cars at work, but the number of the former is being added to.

Bradford.—The City Council is to make application to the Light Railway Commissioners for an order authorising the Council to undertake to construct and work a light railway between Bradford and Leeds.

Returns showing the working of the electric tramways for the fortnight ending August 20th, show that on the Bolton section 5,467 miles were run, and the receipts amounted to £299 19s. 9d., which is equal to 13·16d. per car mile. The total receipts since April 1st, 1899, amount to £2,619 19s. 6d., or 12·49d. per car mile. On the Horton section during the past fortnight, 10,090 miles were run, and the receipts were £668 9s. 1d., which is equal to 15·89d. per car mile. The total receipts since April 1st, 1899, amount to £5,602 2s. 6d., which is equal to 14·25d. per car mile.

Dublin.—The Dublin United Tramways Company has written to the town clerk with reference to the committee's "strong conviction" that it is necessary "to provide for each car a driver or motorman, a conductor to start and stop the car, and a collector of fares." The company says that, since the opening of the electric tramways, more than two years ago, only one accident occurred, due to the falling of wires, which was attended with the slightest injury to any person, viz., the recent falling of the wires under the railway bridge in Amiens Street, where, owing to the bridge being so low, the overhead construction was of a difficult and complicated character. Since the accident occurred the committee have approved of a method of improving the construction of the overhead wires under this bridge which will prevent the possibility of such an accident occurring again. The board therefore see no necessity for employing a third man to manage the trolley rope on each of their cars, which is not required anywhere in the world where electric traction on the overhead system is in operation. It is added:—"The trolley rope is not an essential feature in this system of electric traction, and it is in contemplation to discard its use altogether, as a new type of trolley head is being introduced, which will not be liable to catch in the overhead wires."

A trolley pole broke on one of the electric cars last week, but no one was injured.

The Rathmines section of the Dublin electric tram system (between Terenure and Nelson's Pillar) was inaugurated on 28th ult.

Dundee.—The Tramway Committee last week had before it the tenders for the overhead line equipment of the Perth Road and Lochee Road routes, and these were remitted to the convener and the engineer to report as to the most advantageous tender.

Eccles.—Last week a meeting was held at Eccles of representatives from the Little Lever, Radcliffe, Barton Rural, Farnworth, Worsley, Whitefield, Urmston, and Little Hulton District Councils and the Eccles Town Council to consider a scheme for the construction of electric tramways to connect the above districts with the Salford Docks. The length of the proposed line is about 12 miles, and it will pass through districts with an estimated population of 250,000 and a rateable value of £500,000. The conference was private, but it is stated that a decision was come to to recommend the various authorities represented to agree to the construction of tramways through their districts, the trams to be electrically equipped and worked by a private company. It was decided to seek the necessary powers under the Tramways Act. The conference then adjourned for a month to enable the representatives to lay their views before their respective Councils.

Glasgow.—The Corporation Electricity Department has decided to construct a motor car for conveying members of the Committee and leading officials on their visits to the various power stations. The car will accommodate four persons and obviate the use of cabs.

Greenock.—The Police Board last week considered motions regarding the municipalisation or leasing of the tramways system, and resolved that: "If suitable terms can be arranged, the Board make immediate arrangements for leasing the whole line of tramways within the burgh as an electrical system."

Hastings.—Those who have so far successfully advocated the introduction of tramways into the borough are doing their best to educate public opinion as to the advantages of an electric tram service, by public meetings and the distribution of literature.

Italy.—The authorities of the Lete Mediterranea Railways have placed a contract with the Thomson-Houston Company for the conversion of the railways between Naples and Castellammare, Rome, and Frascati, and Milan, and Gallarate into electrical lines.

Leeds.—There was a short stoppage of the electric car service on the 27th ult. through a defect in the Sheepscar feeder.

Limerick.—A private meeting of the Borough Council was held last week to consider a proposal to introduce electric trams into the city at a cost of £67,000. Messrs. Fitt, solicitor, and Fuller, C.E., attended on behalf of the promoters, and explained the scheme at length. The application was adjourned for further evidence.

Liverpool.—The Tramways Committee has decided, upon the advice of the city engineer, the city electrical engineer, and the general manager, to recommend the Council to apply for Parliamentary powers authorising them to construct various lines of electric tramway in order to complete the system for the whole city. A special Council meeting will consider the recommendation. The city engineer is to arrange with Messrs. Blackwell & Co. for the execution of the overhead work in Stanley Road between the Rotunda Theatre and the Bootle boundary at their present schedule of prices, while with regard to the other routes and extensions the engineers were authorised to obtain tenders.

The laying of the lines for the north extension to Walton of the electric tramways has been carried out so expeditiously that within a week the whole of the street works will have been completed up to Spellow Lane. It is said that early in October the line may be equipped with cars. The laying of the metals from the Rotunda Theatre to Bootle is being pushed forward, and the street works have been carried out up to Commercial Road. It is anticipated that in a fortnight's time the lines will have been laid up to the Bootle boundary, and the Aintree and Fazakerley route will next be proceeded with.

The cart owners are protesting against the rapidity with which the Corporation is pushing forward its electric tram scheme, because of its effect upon the ordinary street traffic.

London.—A correspondent of the *Daily Chronicle* advocates electric traction as a remedy for the overcrowding in London, and he urges the County Council to push forward with its scheme with all possible speed and establish a record for good and quick work. Fixed stopping places are recommended. Our contemporaries might do worse during the silly season than open their columns to a discussion showing the advantages accruing from the adoption of electricity on tramways. These benefits are matter of ancient history to the electrical engineer, but the average Londoner knows little thereof, and he would be more enlightened by such a correspondence than by the trashy rubbish on impossible subjects which has been appearing of late.

Mirfield.—The District Council has resolved to invite the Huddersfield Corporation to extend the proposed electric trams to Mirfield.

Mumbles.—The British Electric Traction Company have, it is announced, just taken possession of the Mumbles Railway and Pier.

Newcastle.—The city engineer has submitted his observations upon the recommendations of Prof. Kennedy and Mr. Hopkinson *re* electric tramways. They are as follows, says the *Newcastle Leader*:—

Both of these gentlemen (Prof. Kennedy and Mr. Hopkinson) agreed that the use of conduit and overhead together is quite practicable; but neither of them is enthusiastic in advising its adoption, and both of them seem to me to have rather a leaning towards the surface contact system, which they both consider to promise well in the future. Kennedy puts the cost of the surface contact system at about the same as trolley; Hopkinson does not give any estimate.

Hopkinson does not advise the combination of the trolley and conduit, and suggests the installing of the trolley throughout, but regarding it as only temporary in the central streets where it may be replaced in future by the perfected surface contact system. I accept Kennedy and Hopkinson as authorities, and adopt their electrical conclusions as accurate. Mr. Hopkinson's proposal to instal the overhead trolley temporarily in the central streets seems to me, however, a doubtful policy. I was inclined at first to agree with it, but on second thoughts it does not settle anything, and leaves the old difficulty untouched. If, on the other hand, the surface contact (or the conduit system) is installed at once in the central streets, it settles the disputed matters once and for all. There may be some future expense in following up the improvement of the system, but, if the experts are right, it will only be in matters of detail that changes will have to be made.

Considering all things then, I am of opinion that the least risky plan will be to put down the surface contact system at once in the central streets at least, to be worked in conjunction with the trolley outside, and to discard the conduit, which is apparently not favoured by the experts, though Kennedy's report to the London County Council is much more favourable to it.

The City Engineer will probably live to rescind his present decision. The New Tramways Committee, it will be remembered, recommends the adoption of the trolley for the centre of the city, and the matter comes before the Council on September 6th.

Rothesay.—The Council has considered the agreement between a committee and the British Electric Traction Company, who propose to purchase the present tramways and run them electrically. There were two clauses submitted. The Council generally adopted the proposal, but one clause was altered so that granite setts will be laid between the rails, and for 18 inches on each side of the rails, the remaining part to be tar macadam.

Sheffield.—On Friday last week Sir Francis Marindin, chief inspector of the railway department of the Board of Trade, inspected the track of the new electric tramways, with satisfactory results.

On Tuesday, Mr. A. P. Trotter, electrical adviser to the Board of Trade, inspected the new electric tramway power station.

South Shields.—Public meetings are being held here to stir up a movement in favour of municipal electric trams.

Walsall.—It is feared, says a local correspondent, that the notice which has been, or is to be given by the Town Council to the South Staffordshire Tramways Company of their intention, six months hence, to determine the agreement dated February 11th, 1892, as to the use of electricity on the lines, and also of the intention of the Council to purchase so much of the tramways as was authorised by the Walsall and District Tramway Order, 1882, may lead to some inconvenience by dislocation of the traffic.

Southampton.—A deputation recently waited upon the secretary to the Board of Trade (Sir Courtenay Boyle) relative to the proposed reconstruction of the permanent way and to the necessity of obtaining increased borrowing powers for the tramways undertaking. The Council last week resolved that, having regard to the satisfactory interview with Sir C. Boyle, "The Tramways Committee do exercise the power given them by the Council on July 26th, 1899, to accept tenders for the reconstruction of the tramways between Portswood Terminus and the Docks, and that it be an instruction to the Finance Committee to provide for the payments from time to time to be made to the contractors in respect of these works from a Special Suspense Account to be created upon the best terms that the Committee may be able to obtain." The provisional order, it seemed from the discussion, was not obtained when it ought to have been, but it was considered that it would not prejudice the Council in the eyes of the Board of Trade when applying for the order if they did not delay the works.

TELEGRAPH AND TELEPHONE NOTES.

A Cape-Australia Cable.—In the following extract from an Australian paper it will be seen that the Eastern group of cable companies do not yet despair of maintaining their hold on telegraph traffic from Australia. They have, it is true, abandoned the absurd claims they advanced for subsidies, guarantees, and a monopoly of the right to land cables at all the numerous places where their existing cables already land. They also volunteer a reduction on the present charge for telegrams to Australia (a reduction which may cause a delay in the reform of the rates to India). The return they ask for this self-effacement is apparently insignificant, but we hope that the experience which the Colonies have had in the past of the dealings with these companies will not fail to show them that the closest scrutiny should be made, and the greatest publicity possible should be given to the terms of the "privilege" asked for. We should not be in the least surprised to find that the nature of this "privilege" will be such as to amount, indirectly or directly, to a joint-purse agreement with the Colonies of West and South Australia at least, as these Colonies are the proprietors of the trunk landlines, the "harassing and annoying delays" on which have driven their old allies, the submarine cable companies, to project the laying of a cable, which will be in direct competition with these inefficient Government landlines, unless some agreement is come to between the companies and the Governments. The extract is as follows:—"The Eastern Extension Company has forwarded to its representative here, by cable, the following outline of a new scheme for an alternative cable *viâ* the Cape:—'As public opinion in Victoria apparently favours an alternative cable *viâ* the Cape, rather than by the Pacific route, and according to the Chancellor of the Exchequer's admission, the company's Cape proposal was also preferred by the Imperial Government, but fell through because Australia refused to assist it, we are willing to meet the difficulty by making the following liberal concessions, namely: We will entirely waive the renewal of subsidy and guarantee against competition, and, in addition, to providing a cable from the Cape all the way to Glenelg, *viâ* Perth, will agree to at once reduce the tariff to 4s. per word, and make further reductions on a sliding scale as the traffic increases. In return for the above the company would only require the same privilege in the Colonies as they have hitherto enjoyed in Great Britain, of directly delivering and collecting national telegrams to and from the public. The length of proposed line would be about 7,700 knots, including connections, thus: Natal to Mauritius, 1,818 knots; Mauritius to Rodrigues Island, 406 knots; Rodrigues Island to Cocos Island, 2,218 knots; and Cocos Island to Perth, 1,862 knots. From Perth the cable would be submarine to Glenelg, South Australia, which would remove the harassing and annoying delays which are experienced with the landlines.' The cost of the line is estimated at £1,500,000. Sir George Turner, when seen in reference to the proposal, said he could not state his views until he had consulted the Postmaster-General; and it was quite possible the matter would have to be referred to a conference of the Australian Premiers."

Glasgow Corporation and the Telephone Service.—The Corporation had another debate last week with reference to the rights of the Postmaster-General to open the public streets and give the National Telephone Company a right of way. There were also some hard things said about the anomalous state of affairs caused by the Government Telephone Act. The Statute Labour Committee's report was before the meeting, and it was stated with reference to the recent decision of the Railway Commissioners against the Corporation in their refusing to allow the Post Office authorities to open the streets for post office purposes, that the sub-committee had had a meeting, and had resolved to appeal against that decision to the Inner House of the Court of Session. The committee had taken the opinion of counsel. It would cost a little money, but after they had gone so far, the committee felt bound, on behalf of the Corporations generally throughout the country, to fight the issue to the bitter end. This course was agreed to.

The Pacific Cable.—A Reuter dispatch from Wellington (August 29th) says that the New Zealand House of Representatives, in committee, has adopted resolutions authorising the Government to contribute towards the cost of the construction and maintenance of the proposed Pacific cable.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	August 25th, 1899
Accra-Grand Bassam... ...	August 1st, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Iquique-Valparaiso	August 15th, 1899...	August 25th, 1899
Serena-Valparaiso	August 18th, 1899...	August 25th, 1899
Nagasaki-Fusan	July 22nd, 1899 ...	August 20th, 1899
Jamaica-Colon	June 30th, 1899 ...	...
Jamaica-Porto Rico (Ponce)	August 15th, 1899...	...
Cape Haitien-Puerto Plata ...	August 21st, 1899...	...
Cape Haitien-Mole St. Nicolas	August 21st, 1899...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Puerto Plata-St. Domingo ...	August 23rd, 1899 ...	...
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien Port au Prince to Miribalais and Jacmel	August 18th, 1899...	...

Wireless Telegraphy.—A New York telegram from Laffan's Agency to the *Times* says:—"Encouraging experiments in wireless telegraphy, in which kites were used, have been made between Harvard College and Milton, Massachusetts. The distance was 12 miles, and there were considerable difficulties, owing to the electric power houses, electric trolleys, &c., on the route. In spite of this, however, it was possible to telegraph at the rate of 10 words a minute, and it is thought that greater success will be achieved when the disturbing elements have been overcome. The process employed was practically the same as Signor Marconi's, but wires hanging from the kites were substituted for poles. It is claimed that these have an advantage over poles, as being more easily adapted for any height or distance."

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos switchboard, motor and trailer cars, trucks and electrical equipment overhead equipment, underground feeders, conduits, road work, &c. for the Barking and Beckton light railways. See "Official Notices" this week.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" August 18th.

Barnsley.—Tenders are to be invited for wiring the Public Hall for electric lighting.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

Bermondsey.—September 13th. The Vestry wants tenders for electric lighting work at the Town Hall. See "Official Notices" this week.

Carlisle.—September 11th. The Corporation wants tenders for extension to steam, drain, and feed pipes, feed pump, and extension of economiser at the electricity works. See "Official Notices" August 18th.

Carlisle.—September 18th. The Corporation wants tenders for extension of switchboard for dynamos 5 and 6, and for traction work. See "Official Notices" this week.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

Germany.—September 20th. Tenders are being invited until September 20th by the Cotton Wool Exchange authorities in Bremen for a complete installation of electric lighting in the new Exchange. Tenders are to be sent to Das Banbureau für die Bremer Baumvoll börse la Dechanatstrasse, Bremen, whence particulars may be obtained.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" August 11th.

Heckmondwike.—September 20th. The District Council wants tenders for the supply of water-tube boilers, economiser, pipe work, steam dynamos and motor boosters, accumulators, switchboard work, travelling crane, mains, arc lamps and posts, and station lighting. See "Official Notices" August 25th.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" August 18th.

Luton.—September 22nd. The Council wants tenders for boilers, superheaters, engines, dynamos, switchboard, steam and other piping, batteries, street conduits, boxes, feeders, arc lamps and posts, and various other plant and machinery for the electric lighting installation. See "Official Notices" August 25th.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Middleton.—September 20th. The Corporation wants tenders for Lancashire boilers, superheaters, economisers, steam pumps, condensers, steam dynamos, balancer and boosters, switchboard, accumulators, cables, crane, &c., for electricity works. See "Official Notices" this week.

Moscow.—*Commercial Intelligence* says that electrical engineers and contractors will shortly be invited to compete for the electric railway for Moscow. The contract will probably require an expenditure of about 20,000,000 roubles.

Oldham.—The Electric Light Committee invites tenders for rolled steel girders, concreting, and other works required in the foundations for "Kleins Tower Water Cooler" at the electric light station, Gas Street, Oldham.

Poplar.—September 6th. The Guardians want tenders for high speed engine and dynamo, electric motors, Lancashire boilers, economiser, and other plant, as briefly particularised in our "Official Notices" August 18th. Mr. Warden-Stevens, the consulting engineer, asks us to notify that Section L., Steam Jet Plant, relates to ejector condensers, jet pumps, and injectors; and Section M., Auxiliary Pumping Plant, to air compressors, centrifugal pumps, and three-throw pumps.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Annes-on-the-Sea.—September 11th. The Council wants tenders for high speed engines, continuous current dynamos, and balancing booster, for electric lighting. See "Official Notices" August 18th.

Salford.—September 12th. The Tramways Committee is inviting tenders for 100 tramcars. See "Official Notices" this week.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices" August 18th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Tiflis.—The Town Council is inviting tenders for a tramways concession, one of the conditions being that the present horse traction shall be replaced by electric traction, the new lines to be also worked by electric power. The Managing Department of the Town Council, Tiflis, Transcaucasus, is open to receive offers until the beginning of October.

CLOSED.

Blackpool.—The Electric Lighting and Tramways Committee have decided to recommend the Council to accept the tender of the British Thomson-Houston Company, Limited, for the 10 car equipments, for which tenders were recently asked.

Cape Town.—Both electric light and electric traction are making headway at Cape Town. At the last meeting of the Municipal Council of the city tenders were under consideration for machinery for the extension of the Dorp Street generating station. The tenders recommended for acceptance were those of Messrs. Sissons & Co. for the supply of two engines, each of 500 I.H.P., for £2,200; Messrs. Clayton & Shuttleworth, four boilers of the locomotive multitubular type for the sum of £2,390; Messrs. Bailey & Co., a pump, £225; and the South African General Electricity Company two dynamos, each capable of an output of 350 kw. as a continuous load, £3,150. It seemed, however, that the South African General Electricity Company had requested a definite reply to their offer in a fixed time, and as the Council could not give this the tender was withdrawn. The Public Works Committee were empowered to accept the next lowest tender. With regard to the electrical tramways, formal consent was given to an extension by the Metropolitan Tramway Company of the lines to Tamboer's Kloof.

Halifax.—The contract for electric lighting work at the Municipal Technical School has been given to Messrs. Laing, Wharton and Down at £405. There were altogether 16 tenders ranging from £361 to £628.

Ingleton.—Ingleton Electric Light Company have let the contracts for the construction of a weir, pipe track, launder and turbine house works, and the electrical machinery contracts are to be let in a few days.

NOTES.

The Glasgow Corporation Contract.—We were credibly informed that the Allis Company tendered for the alternative two-crank engine for the Glasgow tramways, and before our article on page 343 went to press we inquired telephonically at Mr. Blackwell's office whether this was correct. Unfortunately he was away in Glasgow, the gentleman who looks after the Allis engine matters was out, and nobody in the office could give us one word of information. Since we went to press a telegram from the North informs us that the American makers tendered for the three-crank. That portion of the article, therefore, alluding to what we understood to be the American tender need not be seriously considered, nor our remarks on Mr. Parshall's apparent requirements, which are now shown to be unwarranted.

On Monday the Tramway Committee met the representatives of the four offerers, to each of whom eight questions were put. The matter was afterwards discussed for some hours. Bailie Thomson moved that the contract for the four main engines be given to Messrs. John Musgrave & Sons, Limited, Bolton, on condition that they be completed within a stipulated time. Their estimate is £95,516.—Bailie Steele moved that the contract for two of the engines be given to that firm and two to the Edward P. Allis Company, the American firm, whose tender to construct the four engines for £114,000 was originally accepted by the committee. On a division Bailie Thomson's motion was carried, but as Mr. Musgrave could not agree to the stipulation laid down, the meeting adjourned without coming to any definite conclusion. Another meeting of the Tramway Committee was called for the following afternoon to reconsider the matter.

Personal.—Mr. A. F. Malyon Eatrill has resigned his position as engineer-in-charge at West Ham electricity works, he having obtained an appointment with the Electrical Power Distribution Company.

(*Continued on page* 366.)

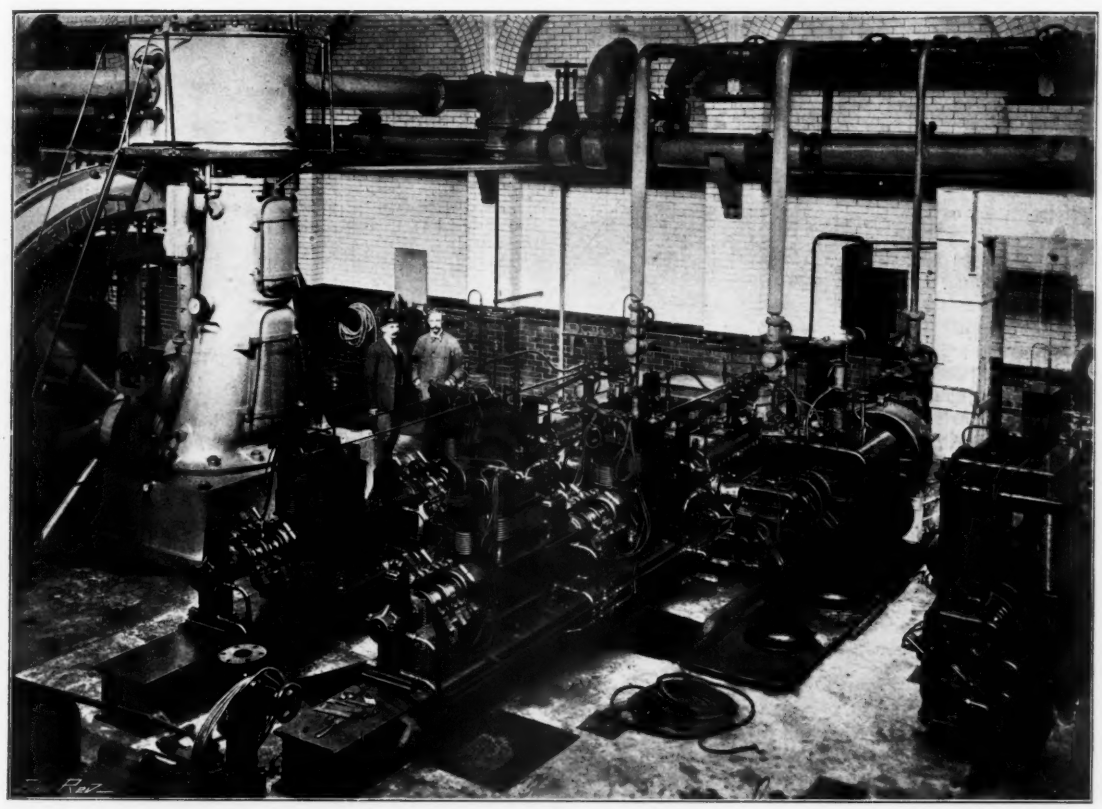
THE CONVERSION OF BLACKPOOL TRAMWAYS.

It is not without a feeling of regret that we write the above words. The Blackpool Conduit Tramway was one of our venerated standards of reference; being one of the earliest attempts at carrying out a system of electrical tramway traction on a practical scale, and certainly the very first successful conduit system, it constituted the outward visible sign of our country's claim to be considered as pioneers of electric traction.

The line was constructed to the designs and under the supervision of Mr. Holroyd Smith, who merits all honour for his courage and originality. It was opened in 1884, has run ever since, and might still have been in operation had it not been for the adverse conditions under which it laboured. What modern engineer would so much as attempt to build and work a conduit which was exposed to sand-drifts and to flooding with sea water? Small wonder that a time came when it was seen to be imperatively necessary to reconstruct the line, and place the conductors out of harm's way. We cannot but agree as to the wisdom of this course, however much we regret the necessity.

It should not be forgotten that in spite of, or, rather, as the result of, the many attempts which have been made of recent years to evolve a perfect conduit, the general form and equipment of the Holroyd Smith conduit have been retained by the best designers, even to the porcelain insulator and the cotter to grip the conductor—modified in construction, no doubt, but in essence the same. The earth return, however, has been avoided by the use of conductors of opposite polarity in the conduit.

The original tramway was laid down by the Corporation and leased for seven years to a company; the Corporation then—in 1892—purchased the plant, &c., for the sum of £15,587 inclusive. Part of the conduit was relaid, and further expenditure of the same kind incurred in 1893-4, but on account of the frequent failures and unsatisfactory working, the whole of the conduit along the Promenade was relaid on a new principle in the winters of 1894—6, at a cost of over £8,000. Still the trouble increased, and after a report from Mr. Quin, who took charge in 1897, a deputation from the Council visited various places on the Continent to examine the systems in use. Their conclusions, which were embodied in a report issued in March, 1898, and were strongly in favour of an overhead system, were adopted by the Council.



Turbo-Generators in the Electricity Works.

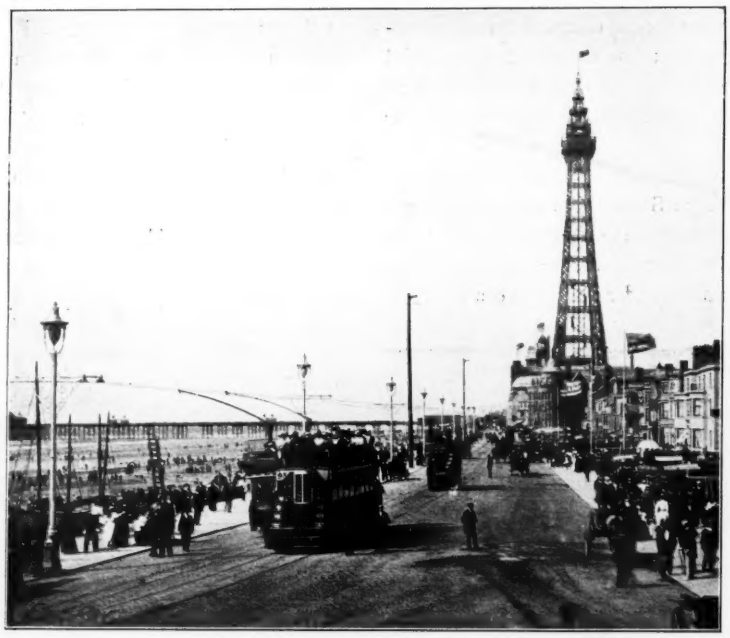
The system now in operation employs the overhead wire and side trolley, with the usual rail return. It is remarkable on the score of the short length of the bracket arms, and the great length of the trolley poles; these peculiarities were due to the desire of the Corporation to avoid disfigurement of the promenade along the sea-front, which is traversed by the cars, and the justice of their choice is evidenced by the artistic and inoffensive nature of the construction seen in the accompanying photograph of the promenade. By this means the local opposition to overhead construction was overcome, thanks to the untiring efforts of Mr. Quin, the Corporation electrical engineer, to solve the problem.

The motive power is derived from the municipal electricity works, the lighting and traction having been combined since

1894; there are two Parsons turbo-generators in the station, of 400 H.P. altogether, which are seen in our view of the engine room. The turbines are compound, and are coupled to generators of the two-pole Parsons type, running at 250 volts, each engine driving two dynamos coupled to the same shaft and joined in series.

The whole of the feeders were made and laid by the British Insulated Wire Company, Limited. There are three feeders of 0·3 square inch cross section, running from the works to the first feeder pillar on each section of the line, and 0·2 square inch from there to the next pillar. Each feeder pillar serves ¼ mile of double wire on each side, and is fitted with four of Mr. Quin's patent maximum and minimum automatic cut-outs, of which we give an illustration.

The cut-outs are provided with a shunt and series coil in opposition, the shunt coil being excited by current brought through a pilot wire from the end of the section, so that if by any chance the trolley wire should be broken, the magnetising current is cut off from the shunt coil, and the switch released, so that current is cut off from the fractured wire before it has time to reach the ground. Should a short circuit come on the line, the current through the series coil causes the pull of the shunt coil to be neutralised, and in this way also the switch is released. These switches have now been in use at Blackpool some time, and have never failed to protect the line when called upon to act.



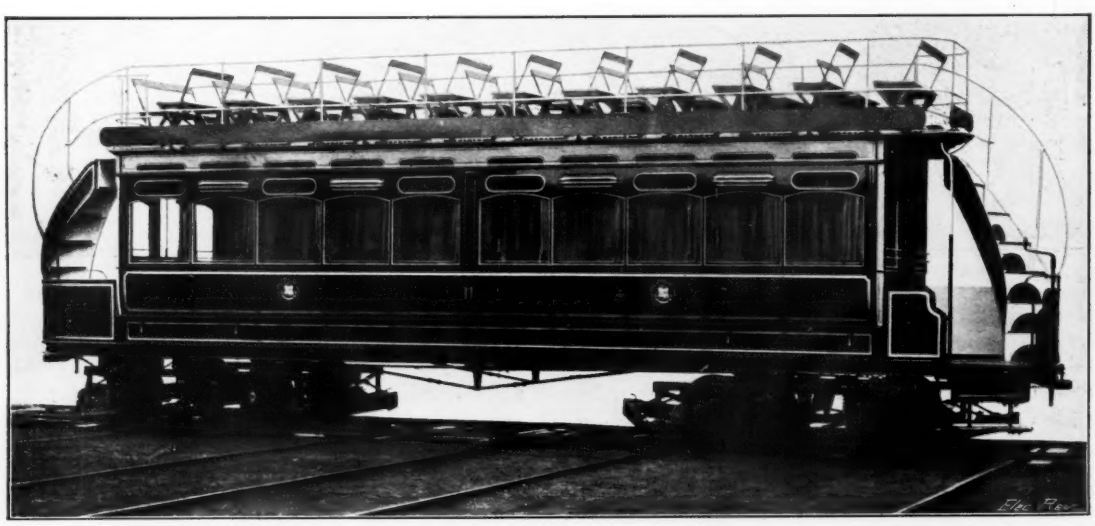
PROMENADE, LOOKING NORTHWARDS.

The special cast-steel points and crossings and the spring points were supplied by Messrs. Askham Bros. & Wilson, Limited, who also supplied the material for the original conduit and for those laid down by the Corporation.

The contract for the poles and overhead line equipment was let to Messrs. Lowdon Bros. & Co., of Dundee, Edinburgh, and Glasgow, who commenced the work in December of last year. The poles, of which there are 152, are of mild steel and butt welded. They are each in one length of 28 feet. The pole at the foot is 8 inches outside diameter, and is half parallel and half taper, tapering from 8 inches to 5 inches at the point; the metal is of a uniform thickness of $\frac{7}{16}$ inch.

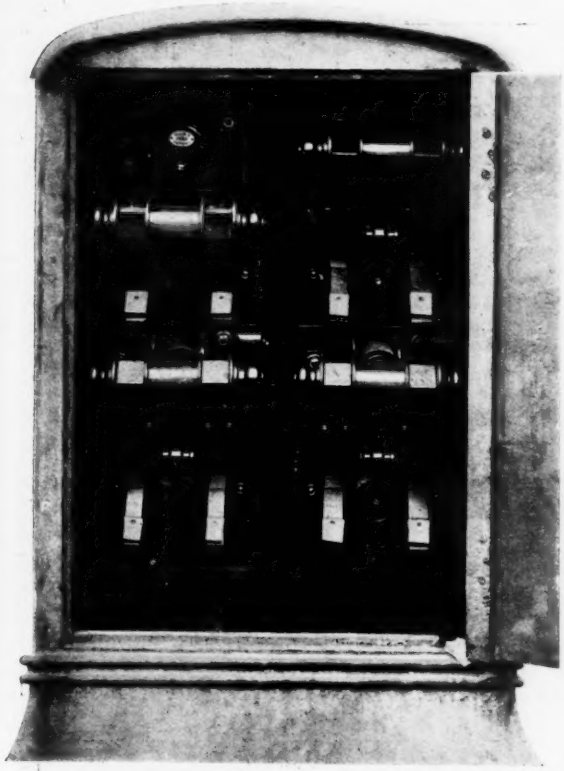
Before erection the pole is slipped through a plinth, which is of cast-iron, with ornamentations, and the Blackpool coat-of-arms, and was designed by Messrs. MacFarlane, of Glasgow. The pole is stepped into a cast-iron plate, with a socket and set screws, at a depth of 5 feet 6 inches from the surface.

The cross arms are Mannesman steel tubes 2 inches outside diameter and ½ inch thick. Instead of being screwed into clamps and bolted round the pole, the cross arm is slipped through a hole in the pole, which makes a much neater and stronger arrangement than the clamps. The cross arms are supported by wrought-iron ornamental scroll work. For about two-thirds of the route the poles are on the pavement at distances varying from about 9 to 18 feet from the track.



BOGIE CAR.

The remainder of the route is on the centre pole system. The maximum span is 40 yards. The trolley wire is



Feeder Pillar with "Quin" Automatic Cut-outs.

000 gauge, and on testing was found to have a tensile strength of 28 tons per square inch.

The clamps and insulators are the standard West End pattern, and the line is doubly insulated, having, in addition to the usual insulation, a rubber sleeve slipped on to the cross arm, over which the hanger is clamped.

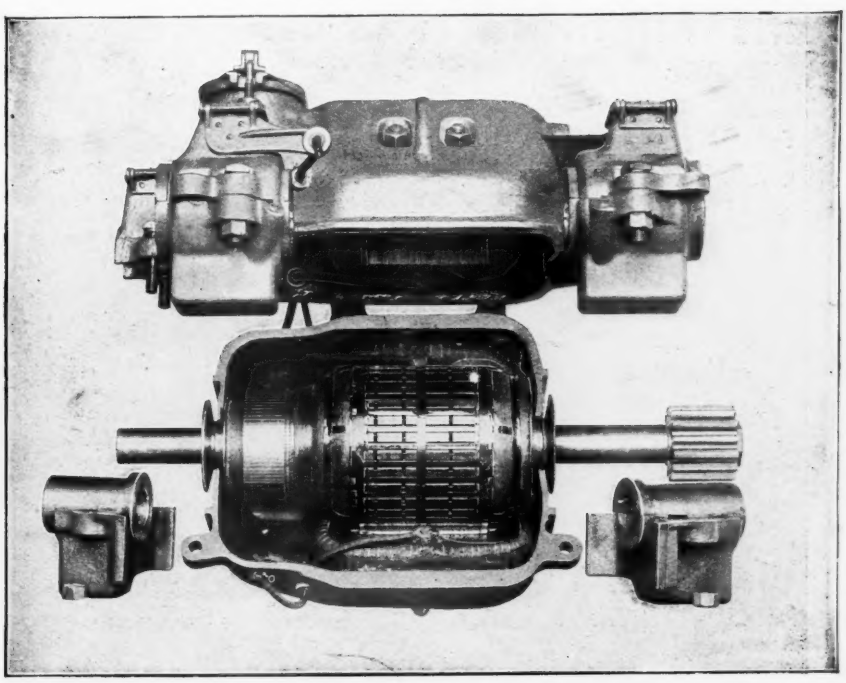
A unique feature of the system is the extremely long trolley arm, which is 20 feet in length from the trolley wheel to the standard. The trolley arm is a single steel tube, tapering from 2 inches diameter at the butt to 1⅛ inches at the point. The trolleys are "Little and Ireland's" patent, with internal concentric springs, so fitted as to give an equal pressure on the trolley head when the trolley arm is moved through a vertical angle of about 20°. Of course such a long trolley arm necessitates an exceptionally powerful set of springs in the trolley standard. The springs, of which there are two pairs, are spiral, and are concealed inside the standard. They are wound to form two double sets, the smaller set being slipped into the core of the larger. These actuate a copper plunger, making contact with a hard copper spring, which again is connected to the controller. Thus the whole trolley arm is perfectly free to swivel, and the tension on the springs may be adjusted by means of a screw attached to the plunger. At some parts of the route the trolley has to swing from behind the car, right out to an angle of 45°. Owing to this it was found necessary to design a special trolley head, which would be durable and would also swivel easily. The new form of head is mounted with ball bearings, both on the turntable and the trolley wheel. The trolley wheel is a light steel casting with a gun-metal liner, a brush being used to conduct the current from the wheel to the trolley lead. The insulation of the trolley arm is also of special design. A thin steel tube is used as a former, and is coated inside and out with mica. This tube is inserted between the trolley head and the trolley arm, and forms a strong and efficient insulation.

The cars are of various ages and various types, some being 14 years old, others about two years old. Six cars have double trucks, four have single trucks, and six have no trucks at all, the car body being carried on axle brackets, as in the old horse cars; on all these cars are trolleys having 20-feet arms.

We illustrate on the previous page one of the bogie cars supplied to the Blackpool Corporation by the Lancaster Railway Carriage and Wagon Company, Limited, before the overhead system was adopted.

The trucks are equipped with G.E.-52 motors, and K.-10 series-parallel controllers with emergency brakes are used, all supplied by the British Thomson-Houston Company, Limited.

The two latest cars which Messrs. Milnes & Co., Limited, supplied to the Corporation are especially interesting, in that they have the largest carrying capacity of any electric tramcars at present running in England, viz., 36 inside and 50 on the roof, making a total of 86 passengers. The inside seats are longitudinal, of pitch pine and sequoia wood slats, supported on turned ash legs, and the roof seats are of the garden type, with reversible backs; they are also provided with Challenger's rainproof fittings. Another interesting feature in connection with these cars is the special design of the platforms; the latter are provided with double staircases and the steps are suspended the full width of car to facilitate loading and unloading, by which means the enormous crowds of passengers are dealt with with the shortest possible delay. The centre part of the platform is framed up on one side, with glass in the upper part to form a protection for the driver.



G.E.-52 Motor with Lower Frame Dropped.

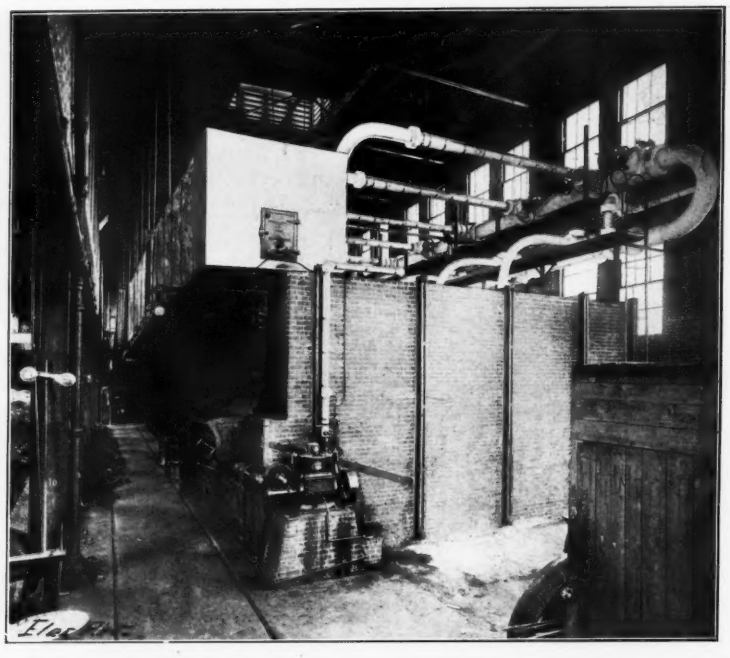
The car body is mounted upon two bogie trucks of the double bar frame type, of Messrs. Milnes' design and manufacture. The car body rests on rollers, and there are vertical rollers mounted on cast-iron sliding pedestals, resting on compound ¾ inch steel spiral springs, with bottom cups and blocks

secured to the bottom framing of the truck, arranged so as to take the end and side thrust of the car ; the truck is also fitted with centre radial pivots and side plates to ensure easy riding. The wheels are of chilled cast-iron. The trucks are fitted with patent roller bearing axle boxes.

The general dimensions of the car are as follows:—Length outside body, 26 feet; extreme length over platform steps, 37 feet 10 inches; extreme width, 7 feet; height inside at centre, 6 feet 9 inches.

The main body panels are of teak. There is a partition framing in the centre of the saloon of figured oak, panelled with ash. With the ends of the saloon framed and panelled with similar woods, and bevelled edge mirrors fixed along the sides and at ends above the windows, the spacious saloon looks very effective.

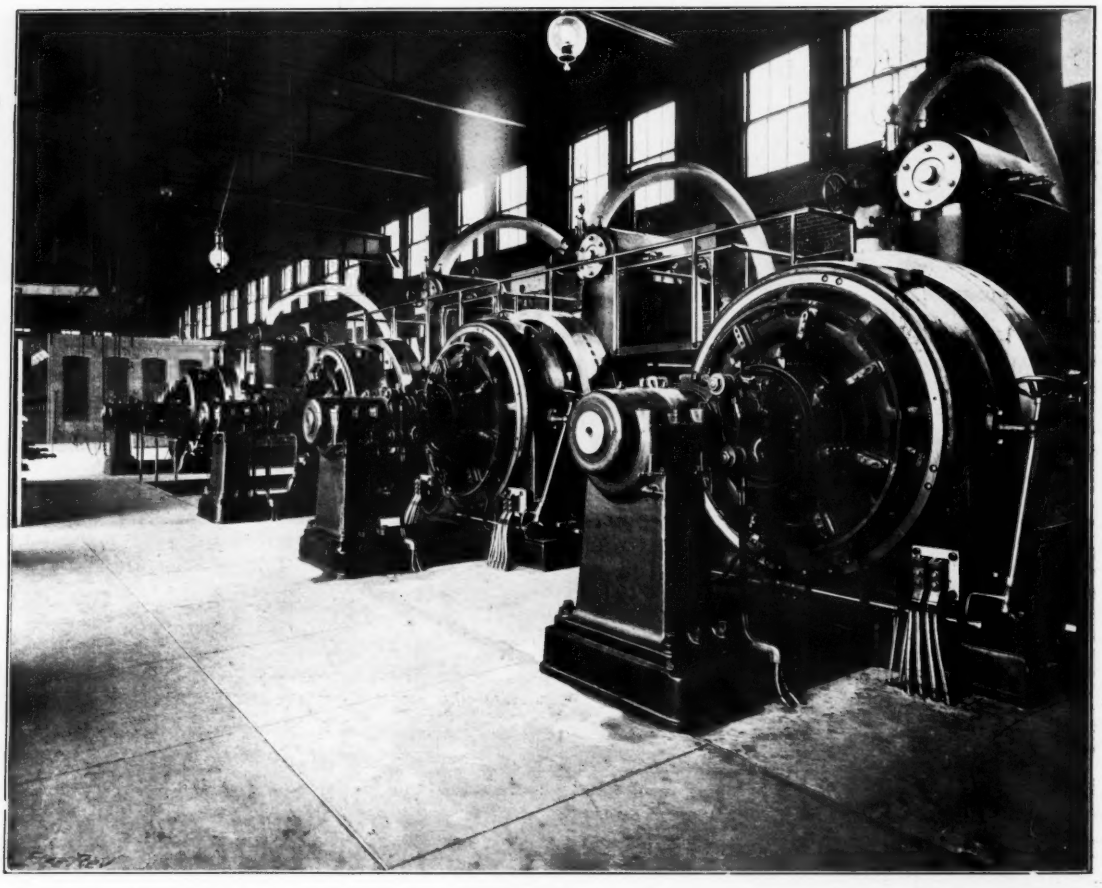
There is a lamp fixed over the canopy at each end of the car, fitted with plate glass at the bottom and bull's-eye 12 inches diameter at the front, provided with interchangeable coloured slides. A hole is made in the canopy for the lamps to fit in so as to throw a light on the platform.



Electrical Equipment of a Great Railway Terminus.—Boilers. (See page 363.)

The present equipment replaces all the conduit system, and extends from Cocker Street (north end of the Promenade) to Victoria Pier (at the south end) and also along Station Road and Lytham Road. Our illustration gives a very good idea of the appearance of the Promenade with the overhead system of construction.

As a general rule, the length of the bracket arm from the post is 4 feet 6 inches, increasing at parts to 6 feet. At one portion of the line there is a distance from the nearest tramway rail to a line plumb down from the overhead line of 15 feet 6 inches, and yet cars have run over that portion of the line with the trolley (at night) at a speed of 25 miles an hour. Of course, considerable difficulties have arisen from time to time. The first trouble was with the insu-



Electrical Equipment of a Great Railway Terminus.—Generating Plant. (See page 363.)

lation of the trolley standards; that has now been got over. The next one was with the trolley heads; in order to get over this, Mr. Quin has had to design a new head, but as this is not yet working, we can give no details of its construction. The leakage of current with the conduit system was at times abnormal; in fact, a heavy shower of rain on many occasions multiplied the output by eight. When it went beyond this it pulled the dynamos up. A shower of rain has now no appreciable effect. As regards the financial side of the question, it seems highly probable, if things go on as they are going, that the year's profits will be able to pay, with the increase over last year, from one-third to half the cost of adopting the overhead system. At present the receipts are some £3,500 greater than they were this time last year, this being due to a quicker and more reliable service. No change whatever has been made in the generating plant except to couple the tandem dynamos in series instead of parallel, the pressure of the old conduit system being 250 volts, of the overhead 500. Short extensions are to be carried out directly after the present season, and further large extensions after the next season, specifications for which work will be issued shortly. The generating plant in the works, other than tramway plant, consists of Ferranti, Leeds and London, E.C.C., and Parsons turbo-alternators; the total normal working capacity is 1,350 KW., of which 550 KW. are given by Parsons alternators. The whole of these machines are run in parallel, and although there were some initial difficulties, these have been overcome, and it is now possible to run any two of them, or any combination of them, in parallel, and leave them on their governors.

We have to thank Mr. Quin for his kind assistance in preparing this description, and for several excellent photographs; as well as the various contractors who carried out the work.

THE ELECTRICAL EQUIPMENT OF A GREAT RAILWAY TERMINUS.

The equipment of the Great South Terminus of the Boston Terminal Company, U.S.A., possesses many features which will be of interest to electrical engineers on this side of the Atlantic. We are also inclined to think that the up-to-date equipment at Boston furnishes a valuable object lesson to the great trunk lines of this country, which are of recent years showing signs of useful advance in the application of electricity to lighting and power purposes—more particularly the former.

The Boston Terminal Station differs from the great railway stations to be found on this side, inasmuch as it is the terminus of a number of the great railway services of the States, viz., the Boston and Albany Railroad, the New England Railroad, the Boston and Providence Railroad, the Old Colony Railroad, the New York, New Haven and Hartford Railroad. The vast local and through traffics which have to be dealt with on these several lines made it necessary that the terminal station should be of dimensions which render it the largest of its kind in the world.

Among the many uses to which electricity is put here may be mentioned arc and incandescent lighting, electric driving, electric elevating, ventilating, and electro-pneumatic switching and signalling. By the kind assistance of Mr. George B. Francis, the resident engineer, we have been enabled to compile from various sources the following notes regarding the installation.

When the engineers took the construction of the station in hand in 1896, it was decided, says Mr. Francis in a paper read this year, to so build it, that the new motive powers, electricity and compressed air, one or both, could be used therein; that a large increase in suburban trains, due to smaller train units and more frequent service, could be had; and that every effort possible should be made to remove the handling of baggage from the passenger platforms.

As to the lay-out of the numerous tracks and buildings we are not much concerned in this article, but with respect to the immense switching system which must be maintained at so large a terminus, we observe that Mr. Francis says: "If the coming motive power is electricity, through a third rail," this will not conflict with the present switching arrangements.

Not the least of the station problems most vital to the successful operation of the station is the track arrangement necessary just outside of the station for the safe and expeditious handling of the trains. An actual count at the old stations indicates about 4,000 movements in 18 hours each day through the switches. By the simple arrangement adopted the station may be operated as a unit, incoming trains on one side, and out-going trains on the other side, or in four sections, one for each of the four main lines.

The switching and signalling system includes a very complete installation of Westinghouse electro-pneumatic interlocking apparatus for handling all the trains using the station to and from the main train shed, and for the frequent trains which are to use the tracks in the suburban loop. The switches and signals, according to a recent description prepared by Mr. Henry J. Conant, the Boston agent for the contractors, are both operated by compressed air furnished from the power house, and the operating mechanism is controlled electrically from interlocking machines in the towers. We hope to refer at greater length to this signalling system at a later period. We may here incidentally remind our readers of the recent announcement of an experimental trial of the Westinghouse electro-pneumatic system on the Great Eastern Railway near Bethnal Green junction.

In June, 1897, a contract was made for the general mechanical and electrical equipment of the station, divided into the following heads:—Interlocking plant and signals, boiler plant, engine plant, ice plant, lighting (arc and incandescent), heating, cold water and refrigeration, ventilation, hot water for cleaning, air for brake testing, elevators, steam heat for cars, protection for roof conductors, fire protection and pumping plant.

At the station there are 235 arc lights, enclosed pattern; about 6,000 incandescent lights, 1,200 of which are in the main waiting room; 25 electric elevators, 10 steam boilers, four electric generators, nine compressors, 45 electric motors, 20 heating and ventilating fans, 25 steam engines, and one travelling crane.

The power plant from which current, &c., for the various purposes is derived, is laid out in what may be termed "tandem" fashion, beginning at the northern end, with the ice and refrigerating plant, the ammonia and air compressors coming next, the engine and dynamo room next, *en suite*, with the stack, economisers, central heating plant and the boiler room, while beyond all, to the south, is the Pintsch gas plant.

The boiler house equipment, as shown in one of our illustrations, comprises 10 boilers, horizontal return tubular type, 72 inches in diameter and 18 feet long. They are made from an extra quality of steel specially rolled, and are designed for a working pressure of 150 lbs. per square inch. The furnaces are provided with an equipment of Roney mechanical stokers, and are adapted to burning widely different qualities of fuel, including "front ends" from locomotives, and either high or low grade coals, with the greatest possible economy and without smoke. The waste gases are passed through a pair of improved circulating economisers, with dampers and by-pass so arranged that they may be operated singly, in parallel, or in series with each other, as the conditions of service may allow, thereby permitting the greatest possible saving to be made at all times. Draught is furnished by a pair of large, slow-running fans, either of which is of sufficient capacity for the entire plant. The products of combustion, cooled by the economisers to a point at which natural draught could not be employed (except by the use of a chimney so large that its cost would be prohibitive), are discharged at a point a few feet only above the roof of the boiler house through a short and inconspicuous stack. Provision has been made for a substantial increase in boiler capacity whenever required, and consideration has also been had to the future installation of coal handling machinery so far as expedient to do so.

The engine house plant was recently described in the *Electrical World and Engineer* by Mr. H. W. Weller, to whose account we are indebted for some of the following notes:—

There are four units, each consisting of a 375-H.P. Westinghouse compound engine, with cylinders 18 inches and 30 inches in diameter by 16 inches stroke, running at 250 revo-

lutions per minute, with steam at 125 lbs. per square inch. Each engine, as will be seen from our illustrations, is coupled to a Westinghouse 8-pole direct current 220-volt compound wound generator. These generators are fitted on the commutator end with four collector rings tapped at quarter-phase intervals into the armature winding, the brushes bearing upon them being connected to two balance coils through which the neutral wire of the three-wire system is brought in to the machine winding. The machines are built with the fields split vertically, so that they may be moved laterally away from the armature, and on account of the three-wire feature the series coils of the compound winding are divided, there being two series coils on each pole, one connected in the positive end and the other in the negative end of the machine circuits.

Sump, Showing Vertical Motors.

The engines are connected to the steam mains by bends, and an 8-inch pipe connects each to the exhaust. The engines are run non-condensing, and the exhaust is taken into the central heating plant for general purposes, but otherwise they are run condensing. Proper iron platforms and stairways are constructed round the engines to facilitate the work of the attendants, the platforms of the three engines nearest the boiler room being connected together for convenience. Space is provided for two more similar units if the additional power is required in the future.

28 inches by 24-inch stroke. The exhaust from the engines is brought to it by a 16-inch steel main on the west side of the basement, the main exhaust passing to the central heating plant through an 18-inch steel pipe. Arrangement is made for a free exhaust into the atmosphere if necessary.

The switchboard for the electrical instruments is of polished white marble securely bolted to an iron framework on the west side of the engine room. It consists of 13 panels. The station panel has mounted upon it two Weston standard voltmeters with illuminated dials, showing the E.M.F. on the two sets of bus bars. One Weston station voltmeter with an illuminated dial is carried on a swinging bracket, and can be thrown on any generator by the use of a plug switch. There is also a circular-pattern Weston ammeter, showing the unbalanced load on the neutral or balance wire of the system. A set of annunciators is installed, connected with the various centres of distribution for the lights, showing which centre is calling for current.

There are four pairs of machine panels, one for each generator, one of each pair being connected to either side of the system. The positive contains the field rheostat, a circular Weston ammeter, a magnetic cut-out switch or circuit breaker, which opens the positive line and also the positive equaliser; also a main

Elevator Machinery.

A handsome gauge-board of polished white marble, supported on iron standards, is placed on the east side of the engine room, containing five polished brass gauges, showing, respectively, the boiler pressure, air-interlocking, vacuum, back pressure, and air-brake testing pressure.

In the basement of the engine room are installed the four balance coils for the generators and also the condenser. This is a jet condenser and pump made by the Deane Steam Pump Company, of Holyoke, Mass., with cylinders 18 inches and

switch controlling both the positive and negative side of the machine, and the positive and negative equaliser. This switch is double-throw, and can connect the machine to either set of bus bars. The two sets of bus bars are provided in order that two different potentials can be carried at the same time, and so that machines can be run in multiple or separately on different services. On the negative panel of each pair is another magnetic circuit breaker, which opens the negative side of the line and the negative equaliser.

There are also four feeder panels containing the various double-throw pole switches for throwing each feeder circuit to either of the two sets of bus bars. These panels also contain the various circular-pattern voltmeters operated by pressure wires from the several centres of distribution, showing the power-house attendant at all times the actual E.M.F. at the various distribution boards.

A polished white marble gangeboard is installed in the office of the superintendent of the power plant, containing five Bristol recording gauges for the steam, compressed air for interlocking, compressed air for air-brake testing, E.M.F. on the high potential, and the E.M.F. on the low potential bus bars.

There are 16 two-wire feeders on the 220-volt circuits, running from the main switchboard at the power house, 12 of these leading to the various centres of distribution, and used for lighting purposes only, the other four sets of feeders being for motor service. There is also the balance or neutral wire of 400,000 C.M., running from the balance coils in the basement, making a complete loop around the station buildings, and taking in all the centres of distribution. The arc and incandescent lamps are connected across from either wire of the 220-volt feeders to the balance or neutral wire, giving them an E.M.F. of 110 volts.

The 12 lighting circuits are divided as follows :—No. 1, the public incandescent lights, such as waiting rooms, lavatories, &c.; No. 2, the basement lights, fan rooms, cellars, &c.; No. 3, the restaurants and other tenants; No. 4, the inward baggage rooms; No. 5, the outward baggage rooms; No. 6, public arc lights, including the train shed; No. 7, suburban platforms in subway; No. 8, office lighting; No. 9, suburban tunnels, both incoming and outgoing; No. 10, the express companies' buildings; No. 11, power house, gas plant, &c.; No. 12, interlocking towers and sump lighting.

At the above centres of distribution are located slate switchboards, provided with the necessary triple-pole switches, which control the various lighting circuits of that centre. A pilot lamp indicates the presence of the current, and a push button signals to the power house when current is required.

There are over 6,000 110-volt incandescent lamps installed. They are Sawyer-Man high efficiency 3·1-watt lamps, and have a regulation within 2 per cent. There are also upwards of 250 enclosed long-burning arc lamps, supplied by the Jandus Electric Company, which consume about 5 amperes at 110 volts. These are used for lighting the train shed, baggage rooms, entrance, and for lighting outside the station under the sidewalk awnings.

The motors are fed from the 220-volt circuit, and the following distribution of the circuits has been arranged :—One operating all the elevators and baggage lifts, except the elevator for the ice plant; one operating the basement fan motors for warm-air heating, another for the ventilating motors and attic fans, and the remaining one for the sump motors and the ice plant.

The various feeders are carried along the roof and sides of the tunnels used for the heating mains, and along the basements of the baggage and waiting rooms, being supported on porcelain insulators, and suitable racks where necessary. The main waiting room is lighted in a very pleasing and artistic manner, harmonising with the architectural features. There are 33 15-light clusters enclosed in opalescent globes, at the intersections of the deep ceiling beams, and 48 10-light clusters, besides 228 side bracket lights, or over 1,200 lights in this waiting room. The fixtures throughout are specially designed and very handsome, those in the grand dining room being of bronze.

In connection with the heating and ventilation arrangements, there are six blower fans or blast wheels for forcing external air through the heaters situated in the various basements. These fans are operated by means of belt from six standard Westinghouse multipolar motors ranging from 5 to 30 H.P. each. Eleven special slow speed vertical motors, varying from 1 to 8 H.P. are direct connected to the same number of attic fans in the roof to insure perfect ventilation. An electric elevator is employed for taking ice from the tank room to the ice house. This is of the Morse belted pattern, operated by a Westinghouse multipolar motor.

There are seven electric passenger and 12 electric baggage elevators, all of which were furnished and installed by the Sprague Electric Company of New York. The elevator machines are seen in one of the pictures. The passenger elevators are located in the head house, and serve the general offices, restaurants, &c. Four of these have a car rise of 70 to 80 feet, and their individual capacity is 4,000 lbs. at a speed of 200 feet per minute, or 250 feet with an average load. The motors are rated at 20 H.P. at a speed of 470 revolutions per minute, but they are readily capable of 50 H.P. for a short time. There are two elevators with a capacity of 2,000 lbs. each at a speed of 100 feet per minute, the car rise being 11 feet and 32 feet respectively. The other passenger elevator has a car rise of 18 feet and a capacity of 2,500 lbs. at 150 feet per minute.

The 12 baggage elevators, or lifts, have an average car rise of 16½ feet, and a capacity of 3,000 lbs. at 15 feet per minute. These were specially designed for the duty required, and the limited space available. They are placed in pockets or pans built of steel plates, formed in the top platform level, and just large enough to receive the hoisting machines and drums. These are built up on 12-inch channel irons, framed into the platform structure at one of the short ends of the well. The motor used is rated at 12 H.P. at 750 revolutions per minute. Steel worms on either end of the motor shaft mesh into bronze gear wheels. The shafts of the worm wheels are direct connected by flanged couplings to the two drum shafts extending along either side of the well. On each shaft are two chain drums, upon which are wound the chains fastened to each corner of the elevator platform. The worm wheels are cut right and left to take up all of the end thrust. Automatic "limits" are geared to one of the gear shafts, and two-foot pushes are provided at each end of the platform, one for the "up" motion, and the other for the "down."

At each gate at top and bottom are placed push buttons for bringing the car to that landing, providing it is not already in service, and the gates are all closed. Automatic locks and safety switches break the circuit, and prevent the movement of the car until everything is secure at the landing. The gates are also automatically locked, except when the car is at that landing, in which case they are automatically released.

Of the above lifts, four are located in the baggage rooms on either side of the train shed, five between the train tracks at the outer end of the shed, and the other three between the tracks at the head house end of the train shed.

The suburban loops and a large portion of the basements are below tide water, so that the disposal of water from the large extent of waterproofed structure involved somewhat unusual considerations. Mr. Conant, in the paper already referred to, says that a large sump well was built near the power house, in which electrically-driven centrifugal pumps were installed (see illustration) to pump away any possible seepage, storm water, and melting snows, which, owing to the grades of the suburban track, will necessarily be carried to the lower levels. The electrical pumping apparatus is controlled automatically by the level of the water in the sump, and a large reserve pump is provided to handle unusual quantities of water. Electric alarms are also provided to notify attendants to start the large pump whenever the water might reach a predetermined danger level.

The entire equipment mentioned in this article was, we understand, carried out by Messrs. Westinghouse, Church, Kerr & Co.

We have to express our indebtedness to Mr. Francis, the resident engineer, for the photographs accompanying this article, and to the papers by Messrs. Francis and Conant, as well as to the *Electrical World and Engineer*, for the material from which this description has been compiled.

Warning.—We are asked to publish a warning to electrical business people in London so that they may be on their guard against a certain probable visitor. The man in question has already entered several electrical establishments to talk business under the pretence that he has orders to place, and after being taken out to dine in the usual way has told a very plausible story and secured a small loan. Needless to say he has never reappeared to repay his indebtedness.

NOTES.

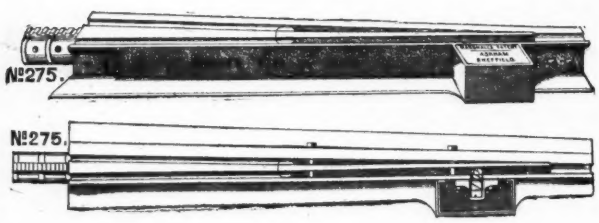
(*Continued from page* 358.)

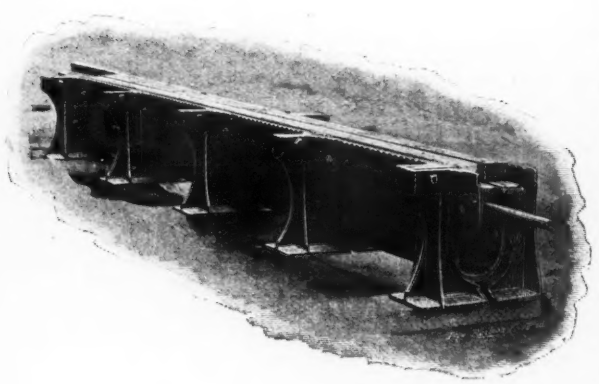
Re "Cassier's Magazine" Electric Railway Number.—Messrs. Laing, Wharton & Down, Limited, send us the following:—

Doubtless many of your readers will read or look through this production, and we, therefore, take the liberty of correcting two errors that are very potent and annoying to us. On both pages, 296 and 325, the overhead equipment is ascribed to Messrs. Greenwood and Batley, who will at once inform you that this is not a fact. We carried out this work under our chief engineer, Mr. Justus Eck, direct for the Leeds Corporation, and if you will refer to your back numbers, we think you will find this mentioned therein. The fullest detail, if our memory serves us right, was given in the *Railway World* of September, 1897, and this remains unqueried to this day.

We take the liberty of calling your attention to this matter, as the *Magazine*, having no correspondence columns, is not well able to make corrections, and we feel that the subsequent number will not have the same circulation and attention as the current one.

Blackpool Tramways.—We give below an illustration of the spring points referred to in our article on the above tramways, as well as of the "Mapple" patent conduit which was supplied by Messrs. Askham Bros. & Wilson for the Station Road section. This conduit is made in sections, each complete in itself, and is so arranged that the steel





channel rail which forms one side of the slot can be raised on hinges. In this way access is readily obtained to the interior of the conduit, and to the insulators, which are bolted to the other (fixed) channel rail. The conduit consists entirely of iron, and is 16 inches deep by 10 inches wide. It is claimed that, amongst other advantages, the ease of repair without interruption to traffic forms a most valuable feature of the system.

More English Orders for America.—A daily paper reproduces the following comments from the *New York World*, in which it refers to and endorses Lord Kitchener's speech at the opening of the Atbara Bridge:—

We are in a position to state that a representative of one of London's greatest industrial and financial concerns is returning to England to-morrow, after having placed an order here for several million dollars' worth of machinery. He confesses that this was of such delicate construction that no shop in England is capable of producing it. A part of his order was for 36 locomotives, and he predicts that he will make frequent trips on similar errands to the United States.

Automobiles at the British Association.—Arrangements for the automobile exhibition in connection with the Dover meeting of the British Association are in an advanced state, and prospectuses regarding space for exhibits, prizes, and general details, have been circulated. The exhibition, organised with the co-operation of the Automobile Club of Great Britain, and under the controlling influence of the Mayor, Sir W. H. Crundall, J.P., who is chairman of the Managing Committee, will be held for three days, from Tuesday, September 19th, to 21st, towards the close of the Association meeting. There are to be certain competitions as to running, control, economy of fuel consumption, design, &c., the Judging Committee for this purpose being as follows:—Mr. W. Worby Beaumont, Prof. C. Vernon Boys, Mr. H. Graham Harris, Major Holden, Sir W. H. Preece, Mr. Boverton Redwood, Prof. Hele Shaw, and Mr. James Swinburne. All communications should be addressed to Mr. F. E. Beeton, the secretary, at Park Street, Dover.

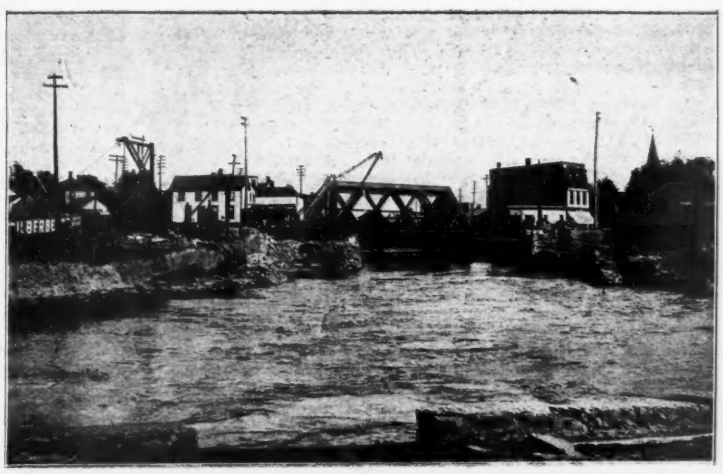
Partnership.—We are informed that the partnership hitherto subsisting between Mr. Reginald Wilson and Mr. W. H. Story, under the name of "Wilson & Story," and carrying on business at 66, Victoria Street, S.W., has been dissolved. In future the business will be continued by Mr. Wilson alone, at the same address, under the style of "Reginald Page Wilson."

British Association.—Among the arrangements for the British Association meeting at Dover is a lecture on the 18th inst., by Dr. Fleming, on the "Centenary of the Electrical Current." It is stated that the lecture has been fixed for this day so as to be coincident with the congress of electricians at Como. It will deal with wireless telegraphy, and be illustrated by experiments.

Effects of Lightning.—The United States Weather Bureau has just issued a statement (which is abstracted in the *Western Electrician*) of damage to property and loss of life by lightning in the United States during the last nine years, from which it appears that 312 persons are killed annually by lightning stroke in that country, taking a fair average. In this respect the worst year was 1895, when 426 Americans were destroyed in this way; in 1898 the mortality was 367. In nine years, from 1890 to 1898, inclusive, five individuals in every million of the population of the United States were killed by lightning. The danger from this cause seems to be least in large cities and in thickly populated districts. Agricultural labourers furnish the most victims. Ohio is the greatest sufferer, the death rate by lightning in that State being 24 in every 100,000 persons of the farming class. The greatest proportion of fatal strokes is found in the Missouri Valley, on the Great Plains, and in the Rocky Mountain region. In 1898 no fewer than 1,866 buildings were damaged or destroyed by lightning involving a loss of $1,446,880. During the same year lightning killed 964 cattle, 306 horses, 30 mules, 116 pigs and 426 sheep, representing a total value of $48,257. All of this destruction of farm animals was accomplished by only 710 "strokes." Much of this damage might be avoided by grounding wires at suitable intervals along lines of barb wire fences, which are sometimes deathtraps to stock, the fatal shocks being inflicted often through the medium of the wires at a considerable distance from the point hit. So far as human beings are concerned, practically all of the deaths occur during the five months from April to September, the highest record being in June and July.

Personal.—Dr. J. T. Bottomley, F.R.S., has resigned all his appointments at the University of Glasgow, and now intends to devote his whole attention to consulting work in electrical engineering. While we regret that the University will no longer have the benefit of Dr. Bottomley's teaching, we feel that in his new sphere of action his scientific attainments will have greater scope, and we wish him a long and successful career as a consulting engineer.

Niagara Falls.—The Niagara Falls Hydraulic Power and Manufacturing Company is displaying the usual energy this summer in the deepening and widening of the surface canal that carries water from the upper Niagara River to the forebay on the edge of the bluff of the lower river, from which forebay the turbines in the power house at the water's edge in the gorge are supplied. The length of the canal is about 4,400 feet. The entrance is about 250 feet wide, but in a few hundred feet of length this narrows down to 70 feet. For a portion of the width of the canal the channel is 8 feet deep, and for the remainder it is 14 feet deep. Drill boats and dredges are now at work adding to its water-carrying capacity, but probably the most notable improvement now being made is in and about the basin of the waterway. This basin is located 300 feet back from the edge of the bank, and is connected to the forebay by two canal feeders. In the past this basin has been of comparatively limited dimensions, but now the line of the banks is being broken away and the basin has been turned into quite a bay fronting on the various mills that stand between the basin and the edge of the bank. This work of enlarging the canal basin is still under way, the picture well portraying the improvement.



At the point where Main Street crosses the canal a new bridge with a span of 100 feet in the clear is being put in, and the canal widened from 70 to 100 feet at that point. A close inspection to the left of the bridge will show the old and new walls of the canal. The canal basin has been deepened, and when all the work has been finished for the summer the capacity of the waterway will have been materially enlarged. All this work is under the personal supervision of Wallace C. Johnson, M.Am.Soc.C.E., who is chief engineer of the Niagara Falls Hydraulic Power and Manufacturing Company.

A New Method of Forced Draught.—This system was described in a paper before the Institute of Naval Architects at Newcastle by Mr. Nelson Foley. It consists in forcing the air into a box placed across the furnace front and into which the ends of the bars are fixed. The bars are hollow and are perforated with numerous small holes along both sides. The forced air escapes at these holes to the fire, and has also an inducing action upon the air in the ash-pit, which is also forced into the fire by this means. The bars can be made in lengths of 4 feet, and it is said they keep cool and clinker does not adhere. Tests have been made showing as much as 72 lbs. of coal consumed per square foot of grate. The jet holes are $\frac{5}{32}$ to $\frac{3}{16}$ inch diameter, and are pitched $\frac{1}{16}$ of an inch apart. The length of grate was only 2 feet 7½ inches. The intensity of the draught was never over 3½ inches, while with 1¾ inches draught the combustion was 29 lbs. per square foot of grate. With 1¼ inches of draught as much as 41 lbs. of combustion was secured, while 40 lbs. was allowed with 1·73 inches of draught. There is not information sufficient to explain the differences of results.

The Thermo-chemical Theory of the Carbon Cell.—More than 10 years ago Donato Tommasi described an electric element in which the electrodes were of carbon, one being coated with lead peroxide, and immersed in a solution of sodium chloride, and he regarded the action as due to the oxidation of the uncoated carbon and the reduction of the peroxide. Reed (Electrical Review, 1896) considered the current to be due to the action of the sodium chloride on the lead peroxide, but this view is untenable, as in that case the coated carbon should be the negative electrode, whereas the reverse obtains. Further, the E.M.F. calculated, according to the author's view of the action, is equal to that actually found for the element. For further details consult the *Bulletin de la Société Chemique de Paris* (III.), Vol. 17, pages 963-964.

The Scourge of Scholarship.—The Vice-Chancellor of Cambridge University, Dr. Alexander Hill, has been condemning the system of granting scholarships. It is time the system was condemned. Under it he finds that boys are overworked, and there is cramming. The early developed brain was selected by the scholarship system. Boys were not properly to be regarded as sheep, which are raised to become mutton at two years, irrespective of the fact that at five years they would be really inferior. But the five years of the sheep is never attained. The sheep has materialised, as intended, at two years. Boys, however, are raised and ripened at 19 years, and this is wrong, for it does them so much harm, that at 49, when they should be at their best, they are done for. Such was the very correct drift of the arguments advanced by the Vice-Chancellor. He advocated a proper regard for athletics as a counterpoise to too much study. Unfortunately, however, no substitute was proposed for the scholarship test, which, we grant, is pernicious enough, and so hard and fast drawn in its rules that we hear boys deplore the date of their birth. Had they been so much younger or so much older they could have got such and such a scholarship. Then a boy whose school career may have been of the best has some trivial complaint on examination day, and he may thereby be thrown out and miss his chance of a university career, which he cannot afford unless with the help of the scholarship. It is a fact that a very considerable proportion of university students who work would not be there but for the pecuniary aid of some exhibition or scholarship. Such pecuniary aid is essential if the universities are to be run on their present lines and retain such workers. At the same time, might not the governors of all public schools devise some better means of awarding scholarships than they now possess, taking into account not simply proficiency at an examination of a few hours, but general conduct during, perhaps, several years, and general capacity? At present, with the narrow system of awarding scholarships, breadth of education is shut out. There is no chance for the all-round boy. The classic who cannot get beyond simple addition in mathematics is able to appear a genius as a scholarship man. The mathematician who only knows various alphabets and letter forms so that he may use the letters in cabalistic formulæ also appears to be possessed of genius until he tries to read or write decent English. The boy, good all round, well read, well balanced, and healthy, has no chance for the best rewards, and it is certain that for good or evil many of the best are thus shut out of the universities, which are too expensive for any not really well-to-do people to afford unaided.

Sheffield Trams.—On Monday next, September 4th, the municipal electric tram system will be publicly inaugurated by the Lord Mayor. There will be special cars run over the section from the Nether Edge to Tinsley for the convenience of the party, and tea will follow at the Town Hall. The public service will commence on Tuesday.

NEW COMPANIES REGISTERED.

Electric Lighting and Traction Company of Australia, Limited (63,334).—This company was registered on August 17th, with a capital of £20,000 in £5 shares, to carry on in Australasia or elsewhere the business of electrical and mechanical engineers, electricians, suppliers of electricity for light, heat, motive power and otherwise, tramway and railway proprietors, contractors, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—R. P. Sellon, 49, Queen Victoria Street, E.C., electrical engineer; W. E. Lane, 14, Durley Road, N., electrical engineer; R. A. Dawbarn, "Wierton," Sidcup, electrical engineer; F. M. Hodson, 14, Harpenden Road, West Norwood, accountant; J. McLachlan, 33, Agamemnon Road, West Hampstead, N.W., assistant secretary; J. Renwick, 29, Hillside Road, Stamford Hill, N., accountant; and G. J. Tindall, 1, Wellington Chambers, York Street, Westminster, articled clerk. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £250; remuneration, £1,000 per annum, divisible. Registered office, 49, Queen Victoria Street, E.C.

Southport Boating Company, Limited (63,307).—This company was registered on August 15th, with a capital of £1,800 in £6 shares, to adopt an agreement with the Mayor, Aldermen and Burgesses of the borough of Southport, and to build or acquire, repair, sell, let on hire, and otherwise deal in pleasure and racing boats, launches, &c., and to carry on the business of electricians, engineers, suppliers of electricity, and manufacturers of apparatus for the generation, distribution, and employment of electricity. The first subscribers (each with one share) are:—Henry Wright (Stem), 79, Snellfield Road, Southport, fisherman; Thomas Blundell, 116, Shellfield Road, Southport, salesman; William Wright (Jenneys), 40, Shellfield Road, Southport, fisherman; William Wright (Roberts), 12, Shellfield Road, Southport, cabinet maker; Miles Blundell, 121, Shellfield Road, Southport, fisherman; Richard Wright, Bank Nook, Southport, fisherman; and John Blundell, 55B, Shellfield Road, Southport, tailor. The number of directors is not to be less than four nor more than nine; the first are William Wright (Roberts), Miles Blundell, William Wright (Jenneys), and Henry Wright (Stem); William Wright (Roberts) is the first managing director.

Portuguese Tramways Construction Company, Limited (63,337).—This company was registered on August 17th, with a capital of £1,000 in £1 shares, to construct or acquire and maintain any tramways, railways, &c., and to carry on the business of carriers of passengers and goods, suppliers of electricity, electrical and mechanical engineers, &c. The first subscribers (each with one share) are:—J. Jewell, 13, Richmond Crescent, N., clerk; F. Davies, Hillwood, Westcliffe-on-Sea, clerk; A. W. Rogers, 8, Denning Road, Hampstead, N.W., clerk; S. M. Nelson, 20, Sheepcote Road, Harrow, clerk; H. A. Milner, 84, Effingham Road, Hornsey, N., clerk; W. MacGillivray, 368, Green Lanes, N., clerk; and T. A. Barson, 1, Inglewood Road, West Hampstead, clerk. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; remuneration, £300 per annum, divisible.

Barnsley and District Motor Car Company, Limited (63,352).—This company was registered on August 18th, with a capital of £5,000 in £100 shares, to build or acquire and work by means of electricity, steam, oil, or other motive power any locomotive and other engines, motor cars, carriages, omnibuses and other vehicles, and to carry on the business of carriers of passengers and goods, electricians, engineers, manufacturers of and dealers in electric, magnetic, galvanic and similar apparatus, &c. The first subscribers (each with one share) are:—Charles Wray, Fair Field House, Barnsley, butcher; E. J. B. Ridcal, Barnsley, solicitor; C. H. Charlesworth, Barnsley, provision merchant; John Harvey, Barnsley, hotel proprietor; William Wray, 14, Cheapside, Barnsley, pork butcher; John Cooke, Beech Grove, Barnsley, butcher; and Joseph Hewitt, Marrow House, near Barnsley, solicitor. Table A mainly applies.

Davy Improved Arc Lamp Syndicate, Limited (63,358).—This company was registered on August 19th, with a capital of £2,100 in £1 shares, to adopt an agreement with W. J. Davy and to carry on the business of electrical engineers, arc lamp manufacturers, electric light makers, &c. The first subscribers (each with one share) are:—J. W. Lee, Budleigh, Salterton, Devon, colonel; C. Bhould, Finsbury House, E.C., clerk; L. H. Wilkins, Finsbury House, E.C., accountant; F. R. Redgrave, 41, Burnley Road, Stockwell, S.W., accountant; J. Cassidy, 95, Holbeen House, Chelsea, clerk; J. J. Bye, 126, Laburnum Street, Kingsland Road, N., clerk; and J. Gordon, 80, Birchanger Road, South Norwood, clerk. The number of directors is not to be less than two nor more than nine; the subscribers are to appoint the first; qualification, 200 shares; remuneration as fixed by the company.

Electrical Wool Pulling Syndicate, Limited (63,360).—This company was registered on August 19th, with a capital of £15,000 in £1 shares, to acquire certain patents for improvements in methods of and apparatus for removing wool or other hair from skins. The first subscribers (each with one share) are:—Seth L. Johnson, 10, Billingsley Terrace, Bradford, manager; W. R. Jones, Boldshay Street, Bradford, wool puller; S. Brooksbank, 63, Bramsley Road, Frizinghall, salesman; E. Johnson, 107, New Cross Street, West Bowling, Bradford, accountant's clerk; H. Goodwin, 7, Grantham Terrace, Bradford, wholesale paper hanging dealer; J. Clayton, 310, Wakefield Road, Bradford, wool and waste merchant; and Mrs. Ellen Johnson, 10, Billingsley Terrace, Bradford. The number of directors is not to be less than two nor more than five; the first are to be appointed by the subscribers; qualification, £250; remuneration as fixed by the company.

Street Lighting Company, Limited (63,388).—This company was registered on August 23rd, with a capital of £30,000 in £1 shares, to adopt an agreement with the Liverpool Meter Company, Limited, and its liquidators, and to carry on the business of mechanical and electrical engineers, ironfounders, brassfounders, millwrights, metal workers, suppliers of gas and electricity, metallurgists, and manufacturing chemists. The first subscribers (each with one share) are:—D. de Ybarrondo, 8, Tower Chambers, Liverpool, merchant; A. S. Hannay, 24, Hacking Hey, Liverpool, cotton broker; J. T. Binning, Phœnix Chambers, Liverpool, underwriter; T. E. Hassell, Queen Insurance Buildings, Dale Street, Liverpool, sharebroker; G. H. Brown, Exchange Court, Liverpool, cotton broker; R. H. Smith, Manchester Buildings, Liverpool, produce broker; F. M. Radcliffe, 9, Cook Street, Liverpool, solicitor. The number of directors is not to be less than three nor more than four; the first are Domingo de Ybarrondo, Anthony S. Hannay and Arthur H. Holme; qualification, £500; remuneration, £100 each per annum (200 for the chairman) and a share in the profits.

Julius Sax & Co., Limited (63,371).—This company was registered on August 21st, with a capital of £18,000 in £1 shares (12,000 preference), to acquire the electrical business of a company of the same name (incorporated in 1892), to enter into an agreement with H. M. Salmony, and to carry on the business of electric light and power contractors, electricians, electrical and mechanical engineers, &c. The subscribers are:—G. Arbuthnot, 52, Eaton Place, S.W., gentleman, 5,000 preference shares; L. G. F. Oppenheim, 40, Great Cumberland Place, W., gentleman, 5,000 preference shares; H. M. Salmony, 119, Coldharbour Lane, Camberwell, S.E., electrical engineer, one ordinary share; A. Bannister, 48, Ambler Road, N., gentleman, one ordinary share; L. Moss, 22, Austin Friars, E.C., gentleman, one ordinary share; L. Wolff, 22, Austin Friars, E.C., gentleman, one ordinary share; T. E. Cowan, 18, Austin Friars, E.C., solicitor, one ordinary share. The number of directors is not to be less than three nor more than five; the first are the first three subscribers; qualification, £1,000.

Dick, Kerr & Co., Limited (63,407).—This company was registered on August 24th, with a capital of £350,000 in £5 shares (30,000 5 per cent. cumulative preference), to adopt an agreement with Dick, Kerr & Co., Limited (incorporated in 1890), and to carry on the business of manufacturers of and dealers in railway and tramway appliances, rolling stock, engines and machinery of every description, iron and steel founders, electricians, engineers, contractors for public and other works, &c. The first subscribers (each with one share) are:—C. T. Cayley, Constitutional Club, S.W., engineer: J. Kerr, 110, Cannon Street, E.C., contractor; J. Gane, 66, Coleman Street, E.C., chartered accountant; G. Flett, 110, Cannon Street, E.C., contractor; H. T. Crewe, 78, Queen Victoria Street, E.C., engineer; H. Brown, 2, Bond Court, Walbrook, E.C., solicitor; and G. W. Carr, 110, Cannon Street, E.C., secretary. The number of directors is not to be less than two nor more than seven; the first are Claud T. Cayley, David C. Ellis, John Kerr, and G. Flett: qualification, £500; remuneration, £150 each per annum and an extra £150 for the chairman. Registered office, 110, Cannon Street, E.C.

Gramophone Company, Limited (63,411).—This company was registered on August 25th, with a capital of £150,000 in £1 shares, to acquire and take over as a going concern the business carried on at 31, Maiden Lane, W.C., and elsewhere, as "The Gramophone Company," to adopt an agreement with Edmund T. L. Williams and William B. Owen, to manufacture and deal in gramophones, phonographs, mutoscopes, biographs, mutographs, and electrical and scientific apparatus of all kinds, and to carry on the business of a telephone, telegraph, and general electric supply company. The first subscribers (each with one share) are:—E. T. L. Williams, 1, Clements Inn, W.C., solicitor; W. B. Owen, Albany Lodge, Esher, merchant; Miss J. M. T. Lewis, 49, West Cromwell Road, S.W.; P. H. Bohanna, 34, Hambalt Road, Clapham, agent; T. D. Addis, 98, Petherton Road, Highbury New Park, N., clerk; G. F. Long, Heath Lodge, Fernham Road, Thornton Heath, accountant; and B. G. Royal, 41, Gower Street, W., engineer. The number of directors is not to be less than three nor more than eight; the first Edmund T. L. Williams, William B. Owen, and Emile Berliner (permanent directors; special qualification, 10,000 shares); qualification of ordinary directors, 1,000 shares; remuneration, £300 per annum, and a share in the profits, divisible (maximum £1,000).

"Perfect" Arc Lamp and Accessories Company, Limited (63,414).—This company was registered on August 25th, with a capital of £10,000 in £1 shares, to enter into an agreement with F. R. Hill & A. V. Gifkins, to manufacture and sell in Great Britain only, the "H. & G." high tension switch, to deal in the "Perfect Arc Lamp," to manufacture, sell, and deal in incandescent lamps, engines, dynamos, motors and electric fittings and supplies, and to carry on the business of electrical and mechanical engineers, electricians, &c. The first subscribers (each with one share) are:—H. Bourne, Lancaster Lodge, Wandsworth Common, S.W., gentleman; H. A. Caspard, 147, Lower Addiscombe Road, Croydon, clerk; T. G. Wallace, 58, Winchester Street, Pimlico, electrician; G.

Hobley, 41, Chetwynd Road, Highgate Road, N.W., clerk; F. E. Janes, The Lawns, Sevenoaks, solicitor; C. S. Lickfold, 1, Draper's Gardens, E.C., gentleman; and J. M. Lickfold, 51, Doughty Street, W.C., secretary. The number of directors is not to be less than two nor more than five; the first are F. R. Hill, H. Bourne, A. W. Scrivener, and W. N. Stewart; qualification, £500; remuneration, £200 each per annum. Registered office, 32, York Street, Westminster.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Construction Company, Limited (39,292).—This company's annual return was filed on August 11th, when 112,100 ordinary and 25,000 preference shares were taken up out of a capital of £400,000 in 150,000 ordinary and 50,000 preference shares of £2 each. 2,100 ordinary and 11,855 shares have been paid for in full, and the remaining 110,000 ordinary and 13,145 preference are considered as fully paid.

F. H. Royce & Co., Limited (41,362).—This company's annual return was filed on July 14th, when 6,000 preference, 21,480 ordinary and 500 deferred shares were taken up out of a capital of £60,500 in 6,000 preference shares of £5 each, 30,000 ordinary shares of £1 each and 500 deferred shares of £1 each. £1 5s. has been called up on each of the £5 shares, and the full amount on 9,466 £1 shares, resulting in the receipt of £16,966. The remaining 12,514 £1 shares are considered as fully paid.

British Thomson-Houston Company, Limited (47,982).—This company's annual return was filed on August 4th, when 24,000 shares were taken up out of a capital of £400,000 in 40,000 £10 shares; £165,310 has been paid on 16,531 shares, and 7,469 are considered as fully paid.

Crompton & Co., Limited (27,200).—This company's annual return was filed on August 2nd, when 32,098 shares were taken up out of a capital of £162,000 in 54,000 £3 shares. £3 has been called up on 30,098 and £90,044 has been received, leaving £250 still due. 2,000 shares are considered as fully paid.

D. P. Battery Company, Limited (44,084).—This company's annual return was filed on July 26th, when the entire capital of £10,000 in £1 shares was taken up. £1 has been called up on each of 8 shares, and 17s. on 9,992, resulting in the receipt of £8,501 4s.

Coventry Gas Fittings, Electrical and Engineering Company, Limited (22,431).—This company's annual return was filed on July 26th, when the entire capital of £15,000 in £1 shares was taken up. 14,500 shares have been paid for in full, and the remaining 500 are considered as fully paid.

West African Telegraph Company, Limited (21,626). This company's annual return was filed on July 26th, when 23,109 shares were taken up out of a capital of £400,000 in £10 shares. £231,090 has been received.

CITY NOTES.

The Chloride Electrical Storage Syndicate, Limited.

The ordinary general meeting of this syndicate was held at Clifton Junction, near Manchester, on Tuesday, 29th ult., Dr. F. H. Bowman presiding.

In moving the adoption of the report and accounts, the Chairman said the shareholders would notice that the course of the company during the past year had been one of steady progress. The storage battery continued to give the greatest satisfaction, and orders had began to pour in. Nothing could hinder electrical storage from being required all over the country. There were already signs that it would be used for electrical traction on all tramcar routes in the centre of cities. He had no hesitation in saying that the company's battery was by far the best in the market, and the only one that could be called commercially successful at the present time. From the balance-sheet the shareholders would see that after providing for debenture interest they had a sum of £16,390, which the directors considered very satisfactory, taking into consideration the rise in the price of zinc and lead, of which large quantities were used in the works. After writing off £5,160 from the various accounts, there remained at the disposal of the company £11,229. Dividends had absorbed £3,703 of this, and the directors proposed to carry forward £7,526, and to declare a further dividend out of that money at the rate of 7 per cent. Further capital would be required owing to the great extension of the business, and it was proposed to raise that by a further issue of debentures. Although he would have liked to report greater success, still the balance-sheet was one with which they had every reason to be satisfied.

Dr. Hopkinson seconded the resolution to adopt the report and accounts, and the resolution was declared to have been carried unanimously.

A Shareholder thought that more particulars of the accounts should be shown, but accepted the explanation of the chairman that this would not be desirable in view of competition.

Mr. Harvey was re-elected as a director, and Messrs. Parkinson, Mather & Co. were re-elected auditors of the company.

In returning thanks for a resolution that the usual remuneration be given to the directors, the Chairman said that the directors had been very ably assisted by Mr. Grindle, the manager, and by all the officials of the company. In the past the directors had declared an interim dividend, and although they had power to do that under the articles of association, he would prefer that the shareholders should confirm the course they had taken.

Mr. Priestly seconded a resolution to this effect.

Mr. Harvey said that before the resolution was put he would like to remark that, considering the present price of materials and what could now be got for batteries as compared with the figures in the early days of the company, he thought there had been exceedingly good management. The company had now a very large amount of orders in hand, sufficient, at the present rate of output, to last for a very considerable time to come, and it would be therefore necessary to still further increase the works.

The resolution as to the dividend was then put to the meeting and carried.

Votes thanking the directors, manager, and staff were responded to by the Chairman, on behalf of the board, and by Mr. Grindle on behalf of himself and staff.

The Brush Electrical Engineering Company, Limited.

The directors' report to be submitted to the tenth annual general meeting to be held at Cannon Street Hotel, E.C., on Friday, September 8th, 1899, at two o'clock p.m., reads as follows:—

"The directors herewith submit the balance-sheet and profit and loss account for the year ended June 30th, 1899. The profit and loss account shows an available gross profit of £57,259 11s. 9d. After deducting maintenance, general charges, interest on debenture stock, and interim dividend on preference shares for the half-year ended December 31st last, there remains a balance of net profit of £26,480 7s. 3d. The directors recommend that this sum be applied as follows:—

	£	s.	d.
To dividend at the rate of 6 per cent. on preference shares for half-year ended June 30th, making 6 per cent. paid for the year	5,400	0	0
„ dividend at the rate of 5 per cent. on ordinary shares for the year	9,000	0	0
„ bonus payable to employés under profit-sharing scheme	1,980	0	0
„ depreciation reserve fund	5,000	0	0
„ balance carried forward	5,100	7	3
	£26,480	7	3

Capital expenditure to the extent of £55,956 2s. 6d. has been incurred during the year on extensions of buildings and plant at Loughborough, to enable the company to meet the growing demand for electric traction and power distribution undertakings in Great Britain and the Colonies. The provision referred to in last year's report with reference to the Workmen's Compensation Act has proved to be more than sufficient to meet the requirements of the case; and the directors propose that the company should continue to effect its own insurance in respect of the Act. The policy of developing the company's facilities for dealing with electric traction contracts has borne good fruit during the past year; and the works are well filled with orders for steam engines, electrical machinery, and rolling stock. The result of the year's trading enables a further distribution to be made to the company's employés under the profit-sharing scheme, with the results of which the directors continue to be satisfied. The directors have decided to make the company's financial year coincide in future with the calendar year. A balance-sheet and report will accordingly be issued for the six months ending December 31st next, and thereafter for each whole year ending December 31st. Mr. J. B. Braithwaite, jun., and Mr. B. H. Van Tromp are the directors who retire by rotation, and, being eligible, offer themselves for re-election. The auditors, Messrs. Cooper Brothers & Co., also retire and offer themselves for re-election.

Prospectus.

The prospectus of the Electric Lighting and Traction Company of Australia, Limited, was before the public at the earlier part of the week, the list closing on Tuesday last. The Electric and General Investment Company offered, on behalf of the Brush Electrical Engineering Company, 20,000 6 per cent. preference shares of £5 each, at a premium of 10s., and 20,741 ordinary shares (£5) at par. In addition 1,400 ordinary shares are issued in part payment of purchase money, 7,859 ordinary shares being reserved to shareholders in the existing Melbourne companies, and these will also be issued as fully paid in part payment of the purchase price. The company, which has a nominal capital of £300,000, will carry on electricity supply business for lighting, traction, and other purposes in the Australian Colonies, which are believed to offer a large field for electrical development, and for the investment of capital therein. The undertakings of the New Australian Electric Company, Limited, and of

the A. U. Alcock Electric Light and Motive Power Company (both already supplying electricity in Melbourne and suburbs, and holding electric lighting orders in certain districts). Extended orders for additional works in the same districts are being applied for. The maximum charge per unit is 9d., but the companies are charging 7d., with discounts down to 5d. The population of the several districts is 216,000, and the price of gas is 5s. per 1,000. During the past four years the two companies have shown an average combined net annual profit of £8,831, exclusive of charges for interest and depreciation. The amalgamation of the two concerns can hardly fail to effect economies, as the two generating plants will be now brought into one set of buildings. The Melbourne City Council is purchasing the rights, plant, &c., of the two companies in the city district, paying therefor £40,000 in cash, but the companies will continue the supply of current until the municipal station is completed. It is not anticipated that the withdrawal of the city supply will reduce revenue, as the suburbs are to be energetically worked. The company will not confine itself to electric lighting, but is already proceeding with electric traction negotiations. There will be a local advisory board of directors at Melbourne, the home board consisting of Messrs. J. B. Braithwaite, jun., J. F. Albright, A. U. Alcock, M. F. Armstrong, and R. P. Sellon. Mr. F. W. Clements, M.I.E.E., is the engineer. Messrs. Kincaid, Waller & Manville being consulting engineers. The registered office is 49, Queen Victoria Street. The purchase price of the two undertakings is fixed at £179,105, and the way this is made up is shown in the prospectus, as are also particulars of contracts entered into, &c. We have often thought that our Australian Colonies offered a splendid field for electrical development and for the profitable employment of English capital. We shall probably see a good deal of this within the next few years.

Manchester Electrical Works.

The *Financial Times* says that the following circular letter has been issued to the shareholders of the Manchester Electrical Works, Limited, by the secretary:—

"Dear Sir (or Madam),—I am instructed by the directors to send out the following letter as a reply to many inquiries received from shareholders.

"Since the circular of December 2nd, issued by the directors, the sum of £900, less charges, being the purchase price of the works by Mr. Thomas, as approved at the general meeting of September 5th, 1898, has been paid. A proportion of this has been absorbed by payment of rent, legal and other charges, rates, taxes, &c. No fees have been paid to the directors, and there are no charges for office expenditure. The balance of cash is at the bank. Securities were taken by the directors in connection with Mr. Rawson's liability to the company. These securities will require careful realisation, and it is hoped that the directors will be left a free hand in the matter, as they are acting in the interests of the shareholders only. Negotiations are pending for the sale of the company's rights in the Woodhouse & Rawson electric filaments, which are acknowledged to be the best in the market.

"The directors do not consider that any benefit would be derived from calling a meeting until they can report more definitely on the company's position. They will, however, not fail to keep the shareholders informed of any alteration which may occur."

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 26th, 1899, were £2,090 6s. 11d.; receipts for week ending August 26th, 1898, £1,212 3s. 6d.; aggregate for half-year to date, £11,990 18s. 9d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 25th, 1899, were £3,699 18s. 9d.; corresponding period 1898, £3,171 0s. 8d.; increase, £531 17s. 7d.

The City and South London Railway Company.—The receipts for the week ending August 27th, 1899, were £895; week ending August 28th, 1898, £866; increase, £29. Total receipts for half-year, 1899, £8,641; total receipts corresponding period, 1898, £8,695, decrease, £54. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 26th, 1899, were £346 18s. 6d.; week ending August 26th, 1898, £278 1s. 6d.; increase, £68 15s. Total receipts to date, 1899, £6,488 0s. 9d.; corresponding period, 1898, £5,357 9s. 9d.; increase, £1,130 11s. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 4,966; 1898, 4,839. Number of cars, 1899, 12; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 25th, 1899, were as follows:—D. U. T. Co., horse cars, £2,525 3s. 9d.; ditto, electric cars, £1,469 12s.; D. S. D. Co., electric cars, £1 639 3s. 8d.; total, £5.633 19s. 5d. corresponding week last year—D. U. T. Co., horse cars, £3 090 14s. 11d.; ditto, electric cars, £523 5s. 4d.; D. S. D. Co., electric cars, £1,240 1s. 10d.; total, £4,784 2s 1d.; increase, £849 17s. 4d. Aggregate to date, £38 023 9s. 7d.; aggregate to date last year, £36,586 7s. 5d.; increase to date, £1,437 2s. 2d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for two weeks ending August 20th, 1899, were £1,671; Miles of track open, 12. Car miles run, 23,124. Number of cars, 21. The receipts for two weeks ending August 24th, 1898, were £643. Miles of track open, 8. Car miles run, 7,443. Number of cars, 10. Increase, £1,028. Total receipts to date, August 20th, 1899, from August 24th, 1898, £20,884. Total receipts to date, August 24th, 1898, from June 30th, 1898, £2,241. Increase, £18,143.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 27th, 1899, amounted to £1,899; corresponding week last year £1,661; increase, £239.

The South Staffordshire Tramways Company.—The receipts for week ending August 18th, 1899, were £703 2s. 6d.; aggregate receipts for 34 weeks, £23,374 6s. 6d.; week ending August 19th, 1898, £700 3s. 2d.; aggregate receipts for 34 weeks, £21,289 5s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

The Transvaal trouble hangs like a sable cloud over the Stock Exchange, retarding enterprise in almost every direction, and causing grave anxiety in all the markets. Despite the huge amount of public money that awaits investment, the owners of the cash decline to use it freely in the Stock Exchange, owing to the political uncertainties of the moment. The electric lighting and kindred departments of the House would be among the first to benefit by a return of public confidence, but, as it is, there is so little business doing, that a change of price of any kind in a quotation is considered noteworthy. As one of the jobbers in the electrical supply section said to us the other day, "We tick the prices on the lists day after day just as a matter of form, and not because there is any need to do it." City of London, however, are 10s. better; Charing Cross and the other two West End companies sharing the same honourable distinction. Firmness is the prevailing feature, the tone throughout the list being very good. Citys still enjoy the attraction of being a good medium for speculation, and the account was arranged on Tuesday at an average rate of 5 to 7 per cent. for carrying over the shares. City of London 5 per cent. Debenture stock is being asked for, and the price has risen two points.

The telegraph market has naturally been agitated by the fears of a Transvaal rupture, to which reference has already been made. Prices of the Eastern Companies keep steady, but the dealers are naturally shy of making close prices, and suspended animation is the order of the market. Eastern Extension shares are stolidly unmoved at the effort which the company is making to improve its Australian business. The American Cable Company's stocks show very little alteration one way or the other. A temporary lull in the "Yankee boom" has resulted in a corresponding quietness of Anglo-American issues, speculators being anxious for a little more light upon their path before adopting aggressive tactics again. West Indian shares maintain their firm front, even in face of the news that is daily received as to the prospects of another hurricane in these islands.

Telephone descriptions are tame and featureless. Nationals at 5⅜, ex dividend, have ceased to attract attention, and the market is waiting for a new move on the part of the company or the Government before tinkering with the price. We might, by the way, suggest to the Stock Exchange managers that while the alterations to the House are in progress some better arrangement with regard to the telephonic service would be worth introducing. At present the Stock Exchange labours under an arrangement which, to the members, combines the maximum of inconvenience with the minimum of proper management.

Brush Electrics have lost part of the ground they gained last week, and the price has fallen to 2 middle. A few sales were made by people who had long given up hopes of ever seeing a rise in the shares, and who took advantage of the late advance to clear out of their holdings. There is a tendency to buy the senior securities of Electrical Supply and Traction Company, but this is retarded by the uneasy feeling that prevails amongst the investment markets generally. Crompton's Debentures have secured a point rise, and an advance of 2 was scored by Aluminium 4½ per cent. Debenture stock. Callender Cable shares retain their rise of last week, and a small premium is already established upon the new Preference shares offered by Henley's.

New issues are nearly as rare as snakes in Iceland, but the Electric Lighting and Traction Company of Australia has been boldly bidding for popular favour. We fancy its reception must have proved a little disappointing to its promoters, and no market for the shares has been made in the Stock Exchange. The company certainly appears to have some chance of success, but to face the music in the dog-days is a trying experience for any new concern, especially when the object is of a speculative character, and one which it requires some faith and enterprise to take up heartily.

The electric railway market presents no special mark of interest. Waterloo and City Ordinary has fallen 1, but the main spirit of the market in the Stock Exchange is out of town, and dealing is more or less a matter of negotiation. Central London shares were carried over at 10½, the rate of contango being 5 to 6 per cent.

Shareholders in the Manchester Electrical Works, Limited, are not likely to be particularly pleased with the circular just issued by the directors in response to a number of questions which have been addressed both to the company and the Stock Exchange. It would appear that the purchase price of the works has now been paid to the company, but we are not told how much of this now remains. The references to Mr. Rawson's liability to the company are vague, and we think a little more frankness would have been appreciated by the patient shareholders.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, August 23rd.	Closing Quotation, August 30th.	Business done during week ended August 30th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	101	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	63 — 66	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115 —116	115 —116	116	115
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 15	14½— 15	14 15/16	14 3/4
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	...	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¼	104½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	½— ¼	½— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9¾	9½
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3¼%	11¾— 12¼	11¾— 12¼	12½	12
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	153 —158	153 —158	156	154
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	100½	99⅞
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	116 —121	117⅛	116½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14½	...
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
820,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	115 —120	115 —120	116	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	102	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4¼%	4¼%	5¼%	10⅜— 11¼xd	10⅜— 11¼	11	10 1/32
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½xd	15 — 15½	15 5/16	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30¼	...
82,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ⅛	¼— ⅛	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5¼— 5⅛xd	5¼— 5½	5 7/16	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14	13 5/16	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14	13⅜	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅛xd	5¼— 5½	5 7/16	5⅜
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	100⅛	100¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	5	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	1%	...	1⅜— 1⅝	1⅜— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10⅝	10 3/16
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	8½	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11 xd	10½ — 11½	11	10⅞
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½xd	6 — 6½	6½	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8½	8 1/16
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	113 —115	113 —115	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11½ — 12½	12 3/16	11 15/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½xd	12½ — 13½	13⅛	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	11 1/16	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 83	81 — 84	83	82¾
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½xd	5 — 5½	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9 xd	8 — 9	8¾	8⅝
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	3 13/16	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	106	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15½	15
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	14½— 15½xd	15⅝	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17	16½ — 17½	17½	16¾
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4½	3⅞— 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15 — 16	15½—16½	16	15¾

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 23rd.	Closing Quotation Aug. 30th.	Business done during week ended Aug. 30th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½xd	3 — 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾— 14¼	13¾ — 14¼	14	13⅞
20,000	Do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	...	11 — 22	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	...	6½— 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	2 — 2½	1¾— 2⅛	2⅛	2
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅜	2¼
125,000‖	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14½	14
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10¾	10¼— 10¾	10¾	10 7/16
178,303	Do. do. do. £8 paid	10	...	...	...	8¼— 8¾	8¼— 8¾	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2¾— 3¼	2¾— 3¼	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 5¾	5¼— 5¾	...	...
630,000‖	City and South London Railway	Stock	1 1/16 %	1 1/16 %	2⅛ %	65 — 67 xd	65 — 67	66½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6¾	6¼— 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛%	6 %	6 %	1⅞— 2¼xd	2 — 2½	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛%	6 %	6 %	4 — 5 xd	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2½— 2⅝	2½— 2⅝	2 9/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600‖	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	12	11¾
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	25 — 26	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	20 — 22	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	22	21
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	103½	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3¼%	3½%	7⅝— 7⅞	7⅝— 7⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	39½	38
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½— 9⅝	9½— 9⅝	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000‖	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	102 —105 xd	101 —104	103½	103

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, 9½—10; 7 % Pref., 10—11.
House-to-House, 4½% Debentures of £100, 103—106.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 2—4.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7⅞—8¼. Debentures, 101—104. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 19.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 30th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	55/-	55/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a " " .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25	£25	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8½d.	8½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10¼d.	10¼d.	..
c " Wire, basis .. .. per lb.	8¼d.	..	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£8	£88	..
g " Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/3	4/3	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	64/9	65/-	3d. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£12 17 6	£13 15	17/6 dec
g Lead, English Ingot .. .. per ton	£14 18 9	£14 10	8,9 inc.
g " " Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 12	£8 7	5s. inc.
d Mica (in original cases), small per lb.	1½d. to 6d.	1½d. to 6d.	..
d " " " medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb	7½d.	7½d.	..
j " Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£12 10	£12 10	..
j " Manila, 24 thread .. per ton	£55	£35	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27 10	£28	10s. dec.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

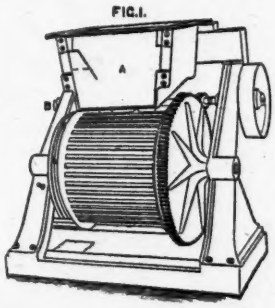
Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

SOME FORMS OF MAGNETIC SEPARATORS, AND THEIR APPLICATION TO DIFFERENT ORES.*

By H. C. McNEILL, Assoc R.S.M.

The first application of magnetism as an agent for the separation of a magnetic from non-magnetic substances was probably the permanent hand magnet used in the machine shop for separating iron or steel turnings, &c., from brass or gun-metal sweepings. Similarly, foreign oats and grain are freed from bits of iron wire, pieces of cutter blades, nails, needles, &c. The railway companies and other large employers of horse labour have found it necessary to subject all the materials utilised for horse food, such as maize and oats, to rigorous mechanical and magnetic cleansing, for which purpose a permanently magnetised steel plate about 4 feet long, 6 inches wide, and ½ inch thick, with the long edges horizontal, is placed transversely, and inclined at an angle of about 35° to a continuous stream of grain fed from a hopper. An automatic scraper, in the form of a belt revolving round pulleys at each end of the magnet, and provided with a brush of leather, removes any accumulation every two minutes. This is pushed to the end of the magnet, and drops into a separate compartment; the grain which passes on is jigged on a three-bottomed perforated tray, by which means not only is the corn or maize separated, but the oats are freed from mixture of smaller seeds, bits of stone, and dust.

With the introduction and wider application of electro-magnetism, not only have machines been devised whereby naturally magnetic iron ores are freed from admixtures of other minerals, but by a preliminary roasting, *i.e.*, the artificial production of magnetic oxide of iron, other ores may be rendered suitable for a magnetic separation treatment. Mr. R. E. Commans mentions† that Sella, in Piedmont,



in 1855, was the first to use an electro-magnetic separator, but to free the magnets the current had to be broken; also that in 1881 Heberle, at the Friedrichssegen Mine on the Lahn, introduced a continuous current machine for separating blende from spathic iron ore after a preliminary roasting. In addition to the separator which bears his name, and which is dealt with in this paper, Mr. Heberle also designed that part of the dressing floors at the Gellivare Company's Works at Lulea, where the apatite, after being separated from the magnetic iron ore with which it occurs, has to be freed from a small percentage of hæmatite before being converted into soluble phosphate.

Other workers, both in Europe and America, including Wenström, Ball and Norton, Chase, Conkling, Hoffman, Kessler, Buchanan, King, Edison, and Wetherill, have all designed machines suitable to treat certain classes of ore which have come under their particular observation, and have successfully dealt with the problems presented by local conditions and peculiarities.

In the summer of 1898 the author had the opportunity of seeing some of the principal magnetic concentration plants in Sweden, and the present paper is mainly confined to these. He is indebted to the various managers of works, engineers, and others for the information freely accorded in every case.

The endeavour has been to present an outline of the machines and ore treatment processes. The sketches are entirely diagrammatic, and have been prepared from the author's hand sketches.

The machines will be described, in each case with the accessory ore treatment processes, in the following order:—

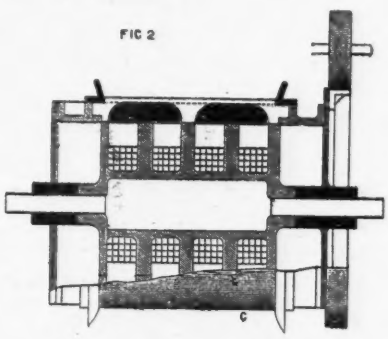
1. The Wenström machine.
2. The Monarch machine.
3. The Delvik-Gröndal machine.
4. The two types of Heberle machine.
5. The Wetherill machine.

1. The Wenström Machine.

This is probably the simplest, and, for the particular purposes which it is intended to fulfil, the most efficient separator at present in use. Unlike most other designs, it is capable of treating ore of fairly large size, and it is not necessary that the stuff treated should be previously dried; its chief use is in such cases where the magnetite iron ore contains inclusions of rock, or where, as in open-cast workings, portions of the containing walls of the ore body get mixed with the ore in blasting and like operations. As a general rule, it is found to be more economical to pass the whole of this material collected together over a Wenström machine, after the "best" of a blast has been dealt with, than to attempt further hand selection in the quarry or underground. In addition, there are other uses to which this separator may be put, such as the treatment of cupola residues and foundry loam and sand; also the recovery of cast-iron shot entangled in blast furnace slag, &c.

Fig. 1 gives a general view of this machine. The material to be treated is fed through a hopper, A, and on to a jigging tray, which receives its motion from a cam arrangement placed on the shaft, B. This tray is inclined, and at each recoil a line of ore is left on the drum. Figs. 2 and 3 show part sections of the drum in directions at right angles to one another.

C is the armature barrel, consisting of a series of soft iron bars, each separated from the other by a bar of wood. D is a stationary field magnet, placed eccentrically with regard to the armature barrel. Non-magnetic end plates, carefully fitted with "jointing," so as to be water-tight, bind up the whole into the form of a drum. The bars of soft iron are internally shaped, so that each successive bar



becomes oppositely magnetised, a combination of greater power being thus exerted on a piece of ore large enough to bridge the distance between two adjacent bars.

The magnetic portion of the ore adheres to and is carried round on the drum until beyond the influence of the magnetic field, when it drops away down a shoot at E, whilst the non-magnetic portion passes down in front of the drum into a shoot at F.

A machine with a drum of 2 feet 2½ inches diameter and 2 feet length, revolving at 30 revolutions per minute, will treat about 5 tons of mixed material per hour. Such a machine is capable of dealing with ore of any size up to pieces that will pass through a screen of 4-inch mesh, and requires a current of 15 amperes, the tension at the dynamo terminals being 110 volts. Although the machine may be and is used on ore which is quite wet, the greatest efficiency is obtained when the material to be treated is dry, and in some cases, as

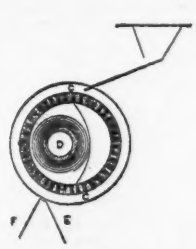


FIG. 3.

at Dannemora (Sweden), care is taken to treat only that ore which is fairly dry, without incurring the expense of artificial drying, whilst in other instances (Grängesberg and Grangen) the ore is treated directly after being washed, and whilst quite wet.

This separator requires but little care and attention when working, whilst the cost of maintenance is practically *nil*.

Generally the most efficient plants are also the simplest. The process usually consists of either a rough preliminary sizing by means of revolving or flat screens, with or without washing, followed by treatment on the separator, or the uncleaned ore may be passed on to the magnetic machine direct, and subsequently screened into different market sizes. At Dannemora the latter method is adopted, and I am indebted to Captain Hammershal for placing at my disposal the particulars given in the following short description of the plant used there.

The ore on arrival at surface is first subjected to a rough hand selection on sorting-floors conveniently arranged near the shaft. Between 50 per cent. and 60 per cent. of the total quantity of ore raised is rich enough to be taken direct to the furnaces. The remainder, which is of any size up to 2 inches diameter, is trammed from the sorting floors to the separation plant, or to the ore heaps,

* Read before the Iron and Steel Institute at Manchester, August, 1899.

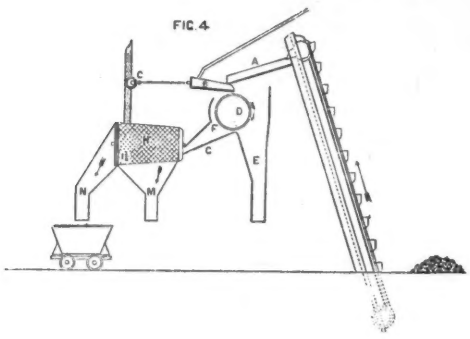
† *Proceedings of the Institution of Civil Engineers*, Vol. cxvi., 1893, p. 63.

for future treatment by the separator. Fig. 4 represents the plant in use.

By means of the elevator shown, the ore is lifted and dropped on to the inclined shoot, A, and so on to the reciprocating table, B, which delivers it to the Wenström separator, D.

The tray, B, receives its motion by means of the small eccentric, C. The unmagnetic, and in this case worthless, portion falls at once down the shoot, E. The magnetic portion is carried round on the drum of the separator in the manner already described, and passes down shoot, G, into the revolving trommel or screen, H.

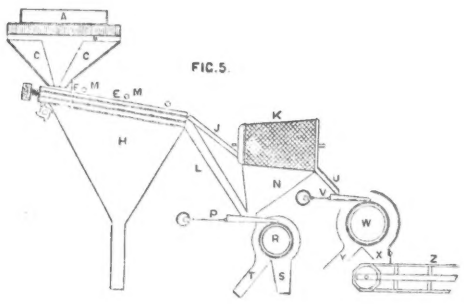
This trommel is of $\frac{1}{2}$-inch steel plate, provided with $\frac{7}{8}$-inch punched holes pitched $1\frac{3}{8}$ inches apart, so that every body under $\frac{7}{8}$ inch diameter passes through and down the shoot, M, the stuff above $\frac{7}{8}$-inch, which



does not pass through the holes of the trommel, being delivered down the shoot, N, two marketable products being thus obtained.

An example where preliminary sizing and washing before separation is found to be advantageous is at Grängesberg (Sweden), and no doubt many of the members of this Institute will remember seeing the actual plant at work.

The mill is built at the foot of an embankment, so that the material to be treated is wheeled either in railway trucks or mine waggons directly into the top storey. During the winter, from obvious reasons, it is found impossible to run the mill; during this time large reserves of ore are accumulated. The railway trucks, when used, are so constructed that the whole sides are capable of being dropped, and rest horizontally on the top of grizzlies which extend from end to end of the truck. In figs. 5 and 6



the truck is represented at A and the grizzlies at B. The ore is shovelled by four to six men out of the truck on both sides, and that which is too large to pass through is hand-picked into the waggons, D, by men and boys standing on the platforms shown. The grizzles are made of bars of iron, rectangular in section, and placed 5 inches apart, so that all the material under that size falls down the shoots, C C, and on to a three-bottomed perforated recoil table E. If small stuff has to be treated, it is dumped directly down the central shoot (fig. 6) from the mine waggons, which are run into the mill on the narrow-gauge rails shown and without being passed over the grizzlies. The three bottoms of the table are placed exactly above one another, and about $3\frac{1}{2}$ to 4 inches apart, and are all actuated by means of the cam-shaft, cam, and springs. The top tray is provided with holes $1\frac{1}{4}$ inches diameter and 2 inches pitch; the middle tray has holes $\frac{3}{4}$ inch diameter, and the bottom one $\frac{1}{4}$ inch diameter. The ore is distributed in an even layer by means of the hinged iron plate F, assisted by the vibrations given to the table, by which means it is gradually worked down the tray, and at the same is subjected to a thorough washing, the water for the latter purpose being supplied by the 3-inch perforated pipes, M M. The result is that all fine particles of ore are washed through the three trays down the shoot, H, and are carried off with the water by launders out of the mill, where boys are engaged in digging small channels, whereby the water very quickly drains away, leaving a coarse powder which is sufficiently rich to be marketable. The stuff under $1\frac{1}{4}$ inches and over $\frac{3}{4}$ inch diameter passes through the holes in the top tray, and is caught by the middle tray; that which is less than $\frac{3}{4}$ inch and more than $\frac{1}{4}$ inch diameter passes through the middle tray, and is caught by the third tray. Both sizes fall into the same shoot, L, and are treated on the smaller Wenström machine, B. The material between $1\frac{1}{4}$ inches and 5 inches, after being thoroughly washed, is delivered from the top-most tray into a shoot, J, and then into a revolving trommel K, also provided with $1\frac{1}{4}$-inches holes, and the ore which passes through these holes is taken by shoot N to join the products from the middle and lowest tray, and is treated by the separator, B. Stuff between $1\frac{1}{4}$ inches and 5 inches is delivered from the end of the trommel, K, on to the feed-plate of the larger separator, W. The material which comes away from the "worthless" shoot, X, is deposited on to a slowly-moving broad metallic belt, Z. Here any pieces of valuable ore are hand-picked off by boys and dropped into a shoot placed on either side of the belt, the worthless portion being left on the belt, and travels into a separate compartment. The use of the

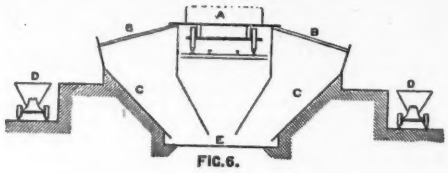


FIG. 6.

belt may be explained by the fact that the weight of some of the larger pieces of ore is greater than the magnetic force exerted by the machine, in which case they would fall off and get mixed with the worthless portion; also that it is more economical to adopt these means instead of hand-spalling and selecting the material to be treated according to more or less exact size. In addition, a lump of the stuff may be partly magnetite and partly unmagnetic, in which case, if the latter happened to come into contact with the drum first, it would not adhere.

Three commercial products are obtained:—

(1) Ore between $1\frac{1}{4}$ inches and 5 inches diameter.
(2) Ore between $1\frac{1}{4}$ inches and $\frac{1}{4}$ inch diameter.
(3) Ore anything up to $\frac{1}{4}$ inch diameter.

The Grängesberg plant was designed to meet the particular requirements at the mine; the ore contains a considerable amount of specular iron, which somewhat easily crumbles, also hæmatite, and differs from that of Dannemora where the ore is compact and very hard, and there is little or no tendency to crumble, hence probably the difference in the methods of treatment and the primary washing, in order to save and eliminate the fine material.

At both Dannemora and Grängesberg the uncleaned ore averages 38 per cent. to 42 per cent., and the concentrates 58 per cent. to 62 per cent. metallic iron.

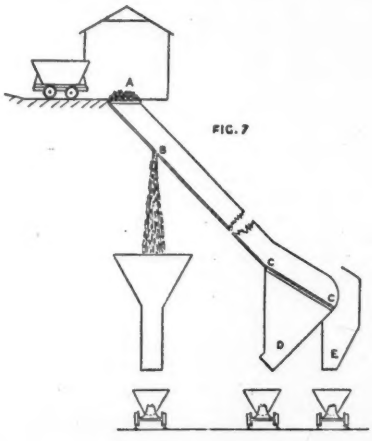


FIG. 7.

The rejected portion of the material consists of quartz, pegmatite (from inclusions and veins running through the magnetite ore bodies), schistose material, &c.

In both the preceding cases the operations of sizing or screening the ore are carried out mechanically either immediately before or after separation, but it may happen that the deposit is so situated as to render it necessary that the ore should be brought down to a convenient mill site, in which case the apparent disadvantages of position may be made use of in many ways. A case in point is at the Slotterberg Mine at Grangen. It appears that a considerable amount of work was done many years ago some 300 to 400 feet up the side of the hill, where large dumps were left by the old workers; in those days there were no magnetic separators, and only the very best picked ore was used; it is now found to be worth while to treat these old heaps. The stuff consists of anything between a powder and 6 inches diameter, and the whole of it, just as it comes to hand, is treated by screening, washing, sizing, &c., whilst on its way to the foot of the hill.

The first operation which the stuff undergoes is shown in fig. 7 at A, where the ore is dumped on to a screen at that point, and is spread out by boys with rakes, and as much of the finer material which adheres to the larger pieces sent through the screen; the latter, which has an area of one square yard, passes everything under 2½ inches diameter, the larger pieces remaining on the screen being hand-picked; after passing through the screen the ore falls down the wooden shoot, which is some 18 inches square in section and lined with iron plates, the whole roughly secured to trestles against the side of the hill, at about an angle of 45°. At B is a rectangular opening in the bottom of the shoot, 2 inches wide, which allows a quantity of the finer material to drop through, but which is skipped by larger pieces as they roll down. Arrived at the bottom of the shoot, the pieces of ore being thus fairly cleaned, fall on to another screen, C C, with which the shoot terminates, where a further separation of the smaller material takes place. This screen is 10 feet in length, and the bars are placed longitudinally and ½ inch apart; the material under ½-inch diameter passes through and is caught in the shoot D, the finer stuff so eliminated, together with that which drops through

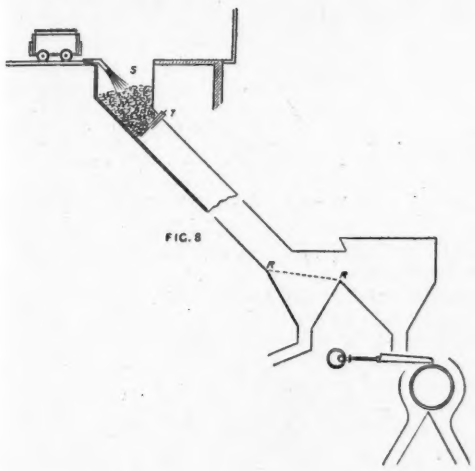
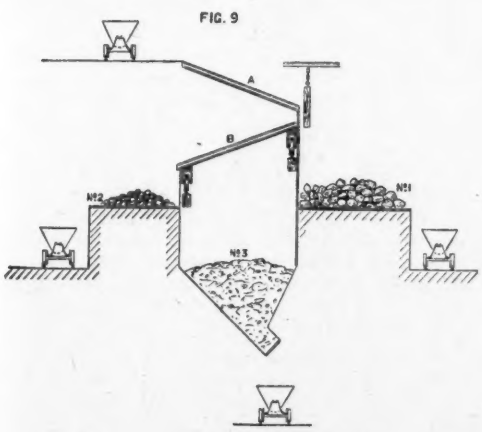


FIG. 8

at B, is dumped near at hand as worthless; and the remainder, of size between 2½ inches and ½-inch, falls into shoot E; from this point it gravitates down an inclined tramway until it arrives at the top of another shoot or launder also placed against the side of the hill, and terminating in the separator plant (see fig. 8).

The product from shoot E is tipped from the waggon into a square chamber at the top of the launder, and is kept in place by a shutter or plate T by means of which the feed of ore down the launder may be regulated, after being washed by water from the hose pipe shown. The height of the ore chamber, S, is 60 feet above the separator, and on its way down the material is well washed. At R R is a fine screen through which passes the finer material still left, together with the water, the residue of washed ore passing on to the Wenström machine.

FIG. 9



In addition to the old dumps mentioned, good ore has recently been discovered near the base of the hill, which is possibly a continuation of the deposit worked, as already stated, higher up. The ore thus obtained is first screened close to where it is mined. Fig. 9 is a sketch of the plant used for this purpose. A is an inclined screen made of old railway metals with an effective opening of 5 inches between each; pieces above this size roll off the screen and form No. 1. Pieces under 5 inches pass through and are caught on screen B, also made of old rails, but placed 2½ inches apart, so that the material of size between 5 inches and 2½ inches falls to the sorting floor and forms No. 2. The ore under 2½ inches that passes through screen B forming No. 3.

No. 1 is hand-spalled, selected, and divided into

(*a*) Almost pure magnetite.
(*b*) Material containing 60 per cent. to 70 per cent. magnetite.
(*c*) Gangue with 12 per cent. to 15 per cent. magnetite.

(*a*) and (*b*) are sent direct to the furnace.
(*c*) is dumped as worthless.
No. 2 is similarly treated.
No. 3, after a further screening, is passed on to the separator.

The top screen may be extended to any length according to the amount of ore to be treated. The under screen, B, is usually a short piece mounted, as shown in fig. 9, on wheels, so that it may be moved under any part of the upper screen that it may be convenient to use. It is also a good plan to divide up the shed into compartments, so that when sufficient ore has been put through to be easily "looked over" by one man, the operation may go forward in another compartment; by these means also the workmen on the lower platform are protected from the falling ore.

(*To be continued.*)

THE STRESSES IN STEAM ENGINES, WITH SPECIAL REFERENCE TO ELECTRIC TRACTION.

One of the claims continually made for American engines is that they are so very heavy and substantial. Generally speaking, the American stationary engine appeals to the writer as being a well-designed, plain, substantial machine, but not in any respect superior in design to the ordinary English engine. How is it, then, that so much is heard about the great weight and substance of American engines, contrary to fact? Simply because everything American has been enormously strengthened during the past few years. A few years ago American machinery was usually held up as the embodiment of scamped material. Americans, not less offensive in their way, jeered at what they were pleased to term the sacrifice of material to British ignorance. However, time has wrought changes. Americans to-day claim that they sacrifice as much material as the most benighted Britisher, and having brought themselves to such an extreme will insist on counting it to themselves for righteousness, and the contrast with their former methods is so great that they really bring themselves to believe that such strength and substance were never before seen. Such, in brief, is the true history of the American belief of to-day, a belief which has no foundation so far as regards any superior design of the American engine. But they have succeeded in frightening some of our ignorant local politicians into the belief that the American traction experience, embodying as it does a long series of disasters and breakdowns of previously too light engines, has evolved a type of engine with which no English engine can compete. It is all a myth. Traction work requires strength, but not more strength than the ordinary good English modern high pressure practice allows. Let us examine the stresses in any engine under maximum load variation. We will assume the fly-wheel to be placed between the crank and its work in contradistinction to the faulty American practice of placing the fly-wheel on the opposite side from the generator.

Assume the engine to be a single crank engine under a full steady load. On each dead point of the crank full steam is admitted to the cylinder. At that point of the revolution there is absolutely no work passing from the crank-pin to the generator. Yet the generator is running under full current without a flicker of the meters. This work can have only one source, and that source is the fly-wheel. There is no other visible or conceivable source of energy. Obviously, therefore, there are two more or less short arcs of revolution during which the engine performs no work. If just before the dead point steam were shut off, the engine would do no work during the next half revolution; all work would come from the fly-wheel. When, after such a half revolution of no work, the crank arrives at its opposite dead point, it may or may not receive a full load of steam pressure. If it receive none, the engine will make another idle half revolution. If, however, steam be admitted, a working half revolution will be made and energy will pass into or past the fly-wheel, but is it not perfectly clear that so far as the stress in the crank and shaft is concerned there is no difference whether the previous stroke has been an idle or a working stroke? Every revolution sees the engine exposed alternately to full load and no load, and no matter how much the load on the generator may vary there can be no excess of stress brought upon the engine beyond the ordinary maximum stress of full boiler pressure, and an engine built for a given boiler pressure can never be put to stresses greater than those due to a steady load at this given boiler pressure carried to the latest point of cut-off. Under certain circumstances, the current output may be so very heavy as to bring an engine to rest in a very short time. In such a case of a load suddenly applied to swallow up the energy stored in a fly-wheel in the course of a very few revolutions, there may be very heavy stresses set up between the fly-wheel and the generator, and these stresses ought to be provided for. Unfortunately for the claims made as to traction stresses being so very severe, it is practically noticeable that American practice, as exemplified in many of the examples sent over to this country, takes so little account of these enormous stresses

as to place the crank-pin between the fly-wheel and the generator, and therefore exposed to all the variations of stress that ever occur.

When the load on an engine with correctly placed fly-wheel is varied from *nil* to maximum, the effect is simply to cause the fly-wheel to vary from, let us say, 101 to 99 revolutions on a normal 100 revolutions. This shows that the maximum possible load variation of this particular engine is such as to absorb in half a revolution 2 per cent. of the fly-wheel store of energy, and the governor varies its position to give full or minimum steam for the next half revolution. But, as an engine sets out its own duty one half a revolution at a time, it is obviously impossible for any load variation to throw upon any part of the engine a stress greater than that which takes place at every half revolution under a maximum steady load. Compared with marine work with a huge screw propeller flung alternately high in air and deep into water, the resistances due to the revolution of an armature in a medium resembling a fluid with a variable viscosity are mere trivialities. The sudden accession of resistance in the field of revolution cannot be compared with the material inertia of a mass of salt water. Catch phrases are very apt hooks on which to snare the unthinking, but it does not require much thought to perceive that the stresses in steam engines arise from boiler pressure, and that no matter how the load may vary it cannot induce the governor to do more than simply admit steam when the piston arrives at the end of the stroke. How such a process can cause huge stresses, beyond those ordinarily provided for, it passes common sense to perceive! Certainly it is possible that the many failures of high speed electric light engines have had their influence in giving to all electrical work a terrifying aspect. But it has been already pointed out in these columns that the one cause of the failure of so many high speed single acting engines has been the intolerable weakness of their crankshafts, such engines often demanding shafts fully sixfold the torsional strength of the shaft of a double acting engine of equal speed and power. As pointed out in the Electrical Review of last week, English practice in electric lighting has long been superior to the prevailing American practice, and there is no reason whatever for doubting the possibility of vastly improving on American traction practice. There is more of it in America it is true, but English practice already passes American in its general features and careful execution, and America has no monopoly of suitable engines. Abnormal stress is a bogey that has been made very useful, but it is high time that clear and truthful conceptions should be gained on so important a subject.

To give fixity of ideas, let an engine of 160 H.P. be assumed at 240 revolutions per minute, with a fly-wheel equivalent to a rim of 4,020 lbs., at a velocity of 80 feet per second. Then, in each stroke of the engine, there is developed 11,000 foot-pounds of work. The stored energy in the fly-wheel represents 400,000 foot-pounds, of which 3 per cent. approximately represents the regular addition of energy per stroke, and should measure the variation of velocity in one stroke under maximum load variation. The engine would then run about 4½ seconds under full load, and no steam.

The speed variation of an engine under maximum load variation is thus strictly a function of the fly-wheel. The sudden addition of load early in a stroke will at once check the fly-wheel velocity, and bring into action the inertia governor and thereby prolong the steam admission. It would approximate a late steam admission. At worst a load variation can only endure one stroke before it is met by the countervailing action of the governors, and in the above engine this is one-eighth part of a second. The speed variation between full and no load is a function of the internal energy of the governor itself—its general sensitiveness. This is simply determined by natural laws. These laws are well known, they are not the monopoly of any climate, or any maker, or any nationality, though it would appear as though there had been an attempt to corner them to uphold untenable claims. The easiest engines to govern are those of highest rotative speed, and as high rotative speed is more particularly English practice, the claims made elsewhere may well be doubted, unless sustained by physical laws. In the Glasgow engines, so much to the fore at the moment, the rim velocity per second is probably about 75 feet per second at most, referred to the whole wheel. The stored energy is thus barely 20 million foot lbs. At 5,000 H.P., the work per half revolution will be fully 1 million foot lbs., and the ratio to the fly-wheel energy will vary according to the relative positions chosen for the cranks.

Finally, one point more as to the enormous stresses due to traction. The effect of a suddenly applied load of 100 H.P. is at most equal to a steady stress of 200 H.P., and for this the shaft between generator and fly-wheel must be designed. A traction generator has no mechanical or material inertia to overcome when a sudden accession of load is put upon it, and this fact limits the maximum possible stress in the shaft to double the ordinary. Now, all crankshafts are designed in view of the fact that they receive a torsion from the crank which varies in a single crank engine from *nil* to a maximum of considerably above the mean torsion. After all, therefore, the difference of shaft diameter in any engine, before and after the fly-wheel, is not necessarily enormous. Allowing as much as 50 per cent. excess stress, a 24-inch shaft would become 27 inches beyond the fly-wheel, a 12-inch hole being assumed through the whole, or

$$D = \sqrt[3]{[1.5\,(d^3 - d_1^3)] + d_1^3}.$$

The dimensions given for the Glasgow engines are open to severe criticism, as is also the design of the shaft as a tapering structure.

Award.—The Cape Asbestos Company, Limited, has been awarded a gold medal and diploma of merit at the Greater Britain Exhibition, West Australian Section, Earl's Court, for their exhibits in blue asbestos removable coverings for boilers, steam pipes, &c.

THE INSTALLATION OF STEAM BOILERS.

VI.

For many years the furnaces of a Lancashire boiler were probably its weakest part. They were lap riveted both longitudinally and circumferentially, and each ring of the furnace tube was often very far from truly circular. The introduction of the butt joint for the longitudinal seams was a great improvement, but even with this improvement furnace tubes were not strong against collapse. It was found, in course of time, that short tubes were much less liable to collapse than were long tubes. Even the ordinary ring seams were a source of strength. Tubes were then stiffened by the use of rings of ⊥ iron (fig. 15) used as joint rings

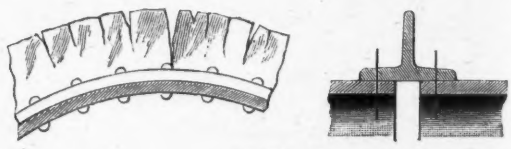


Fig. 15.

between adjacent rings of plate. The fault of the tee iron is that the part riveted to the plates becomes hotter than the web which projects into the water, and, in expanding while the web remains cooler, it causes the web to split. This fault was remedied in the Bowling hoop (fig. 16), which was

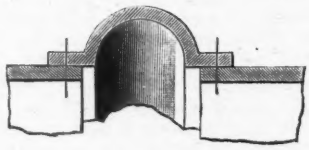


Fig. 16.

also supposed to act after the manner of a concertina and give elasticity endwise. It did not do so, but nevertheless, the Bowling hoop was an improvement, and gave anti-collapsive resistance. In the case of old boilers, it became customary to rivet rings of angle iron round the furnaces for purposes of strength. At first they were closely attached to the plates, but troubles of overheating arose, and rings became split, just as in the case of the T rings of fig. 15. The best system of attaching these stiffening rings is that of fig. 17. The ring was attached by wedges around the

Fig. 17.

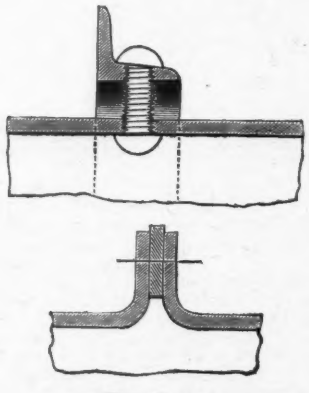


Fig. 18.

furnace tube, and holes were drilled through both ring and plate. These holes were tapped and a screwed bolt was tightly screwed into the two and riveted over on the water side. The whole of the ring was thus of one temperature, the space between the ring and furnace plate being an inch. But nearly all new boilers, 20 years ago, were already con-

structed with the Adamson flanged seam. In all other seams and rings there are rivet heads exposed in the furnace, edges of plates were also exposed, and in process of time such edges often became split and burned. They began to leak, and required frequent attention and repair. The flanged seam of Adamson, fig. 18, cured all these faults and had little to condemn it, has held its own to the present day, and appears likely to do so, for it seems to give to a furnace tube all necessary strength against the highest pressures, and it is the favourite seam in competition with the corrugated and the ribbed plates of more recent introduction. In the flanged seam there is neither head of rivet nor edge of plate in the furnace, and the flanging together with the flat ring between the flanges gives great rigidity, and also there is some longitudinal elasticity secured, which, however, is very trifling. In the most approved modern construction the rings of tube are first welded up solid and truly circular. They are then heated and flanged, a process which puts to proof the soundness or otherwise of the welding. They are then turned on the edge and face and put together by machine riveting with a turned joint ring. So constructed a furnace tube is a good and true mechanical piece of work. It deviates a mere fraction from strict circularity, and is as strong as any part of a boiler. The rings of plate which come next to the boiler end plates are often made stouter than the remainder, the better to withstand the severer stress which comes upon them at the attachment flange of the end plates. The ring next the back end plate is usually about 6 inches smaller in diameter than the rest of the tube, to which it is joined by a tapering length. In this way the back end plate is permitted to be attached by an inside flange to the shell and still preserve sufficient elasticity. The gusset attachments are also enabled to be sufficient and proportionate, and finally space is left between the two tubes to admit of a man passing between them into the lower part of the boiler. We need scarcely discuss the attachment of cross water pipes in the tubes. These are sometimes flanged and riveted, and sometimes are welded in. In either case recent practice has come more and more into line with our frequent condemnation of these useless encumbrances. Experiment has shown that they do not add to efficiency, and they do not aid circulation either, nor can it well be urged that they add to the strength of a furnace tube, of which the weakest part, namely, the furnace, is the one part, in which not even the advocates of tubes will advise them to be fixed. Further, they tend greatly to cause smoke, and check proper combustion, and they make a boiler very sooty on the one hand, while, on the other, they prevent proper access for the sweep and for the inspector, as well as increasing many times the need for inspection.

These pipes are often specified owing to some lingering belief in their efficacy, but it is difficult to discover how any engineer of experience should continue to prescribe these simply weight-producing impedimenta. Even boiler makers, who profit, we may presume, by the sale of such tubes, have begun to look askance at them, and to shirk putting them in even where originally specified. Our drawing of the boiler end plate shows how the furnace tubes are arranged upon these end plates in relation to the centre lines of the boiler. We have already pointed out that the space left between the connecting rivets of the tubes to the end plates and the lowest rivets of the angle iron attachments of the gusset stays must be 10 inches, a figure that seems to give fair results and one that has been attained by a long series of practical experiments. A suitable diameter for the furnaces of a Lancashire boiler seems to be two-fifths of the shell diameter. This allows fair room for cleaning between shell and furnaces and keeps the flanged seams clear of the shell sides. In order that the flanged seams of the two furnace tubes may not touch, it is arranged that the front end ring of one tube is 6 inches longer than that of the other tube, and conversely at the back end the final rings differ in length by 6 inches. The corresponding seams of the two tubes are thus 6 inches apart throughout. As regards strength against collapse the Board of Trade rule for Adamson flanged seams is

$$\text{Working pressure} = \frac{8{,}800 \times \text{T}}{3 \times \text{D}} \times \left(5 - \frac{\text{L} + 12}{67{\cdot}5 \times \text{T}}\right),$$

where T is the thickness in inches, L is the pitch centre to centre of the flanged seams, and D is the external diameter of the furnace. This rule supposes steel of an ultimate tensile strength of 26 to 30 tons. For a 40-inch diameter furnace ½ inch thick and 23 inches pitch the rule gives a working pressure of 132·5 lbs. per square inch. Lloyd's rule is much simpler, the working pressure being $\frac{1{,}000 \times (\text{T} - 2)}{\text{D}}$, where D is the external diameter in inches, and T is the thickness in sixteenths of an inch.

The furnace just named would show 150 lbs. working pressure by Lloyd's rule. The variety of satisfactory furnaces is so great, including the plain corrugated, Purves' ribbed plates, Morrison's suspension ribs, that a full discussion of the subject would occupy too much space. The different rules may be found in works on boilers or in the abstracts of Board of Trade and Lloyd's rules which are given in Kempe's Year Book. We need not discuss furnaces with plain joints. No modern boiler is now made for good work with anything less strong than the Adamson flanged seam. We may add, however, that the resistance to collapse increases with increase of tensile strength of the steel used, and this fact is something of a temptation to secure strength too dearly. The Leeds Forge Company advise, we believe, that steel for furnaces ought not to exceed 27 tons tenacity, though others have admitted 28 and 30 tons. The Germans who made the Fox furnace, in Germany, stated at one time that no trouble had arisen from 16,000 furnaces made from steel of 23 to 26 tons, but the 500 they had made from steel of high tensile strength had given more trouble than the previous 16,000 furnaces.

Experience generally points to the superiority of milder steel for furnaces. There is practically no cracking or splitting of any kind with this material. We need hardly say that, as with boiler shells, no fittings must be attached by bolts to the furnaces. Practically, the only things to be attached are the small angle iron lugs which carry the fire-bar bearers. These lugs should be attached by two rivets each, and it is an argument in favour of bars made in two lengths, that the weight of the grate and fire can thereby be distributed better than where long bars, supported only at the two ends, are used. In this case, however, the weight can be carried at the back end of the bridge casting, and we think that, with short bars partially carried at the centre, the supporting lugs may with advantage be tied across the furnace to each other by a flat stay to resist any possible spreading pressure due to the weight. So far we have spoken only of plain Lancashire boilers with circular flues throughout. For high pressures we consider the circular flue essential. Any departure from circularity can only be counteracted by the use of water pipes as struts to resist the inevitable collapse which would otherwise occur. Lancashire boilers are, however, sometimes made in which the back ends of the furnace tubes are replaced by numerous small tubes. While in themselves safe, they prevent entrance to the flues through the furnace, and they do not form so reliable a stay between the end plates as do the plain tubes, and they are less to be commended for bituminous fuel than for coke or other smokeless fuel, for which they should be efficient in adding to the heating surface. With these tubes it also becomes necessary to afford a stay or suspension to the furnace tubes from the shell in order to prevent too severe a stress on the ends of the small tubes and probable leakage. Some of the small tubes should also be nutted stay tubes, and the longitudinal bolt stays, usually omitted now from Lancashire boilers, should be retained as a safeguard. Numerous modifications of the Lancashire boiler have from time to time been made and patented, but it is safe to say that very few possess serious merit, many are absolutely dangerous, others are unscientific, and practically all cease to possess such merits as may be apparent at a low pressure when put to the stress of modern high pressures, which demand first either perfection of form or simplicity of staying such forms as are not self-supporting.

Gas.—There was a failure in the gas supply at Helensburgh, near Glasgow, at a busy hour on Saturday night, the place being plunged into darkness owing to water getting into a valve at the gasworks.

INTERNATIONAL CONGRESS OF TELEGRAPHISTS.

Result of Professional Competition.

The jury have at length published their report on this competition, and we are able to give the details for the first time in English. For the Hughes apparatus the test was the transmission of 1,000 words in French, Italian, English, and German. The languages were equally divided. In addition, 200 groups of figures, not exceeding six figures to the group, and 100 words taken from a commercial dictionary, were sent. The times, &c., of the first nine competitors were as follows :—

Hughes.

No.	Competitors.	Time employed in transmission.	Surplus of time resulting from errors.	Total time.	Prize obtained.
		M. S.	M. S.	M. S.	
1.	Grueber, Joseph (Munich)	32 38	Zero.	32 38	First.
2.	Cappanera, Giuseppe (Rome)	33 45	0 15	34 0	Second.
3.	Blein, Francois (Lyons) ...	34 29	0 15	34 44	Third.
4.	Käess, Otto (Munich) ...	34 20	1 0	35 20	Fourth.
5.	Michel, Fritz (Berne) ...	35 19	1 15	36 34	Fifth.
6.	Di Palma, Enrico (Naples)	36 24	0 15	36 39	Sixth.
7.	Ristori, Federico (Rome)...	36 35	0 45	37 20	Hon. mention.
8.	Mautone, Pasquale (Bari)	36 38	0 45	37 23	„ „
9.	Geronimi, Luigi E. (Milan)	35 52	2 15	38 7	„ „

The Morse test was divided into two parts, viz., transmission and reception. For the receiving test, 650 words were sent by means of a Wheatstone automatic transmitter working with a single current to a Morse receiver so arranged that the reception could be by sound or slip. For the sending test a like number of words were sent by the competitor. For each error not corrected, 20 seconds were added to the total time. The times, &c., of the first nine competitors were as follows :—

Morse.

No.	Competitors.	Time employed in transmission.	Surplus of time resulting from errors.	Time employed in reception.	Surplus of time resulting from errors.	Total time.	Prize obtained.
		M. S.	M. S.	M. S.	M. S.	M. S.	
1	Geronimi, Luigi E. (Milan)	20 10	zero	20 52	1 40	42 42	First.
2	Mautone, Pasquale (Bari)	21 16	0 40	24 5	4 40	50 41	Second.
3	Franchetti, Attilio (Florence)	20 42	zero	24 0	6 0	50 42	Third.
4	Meliarca, Ottavio (Palermo)...	22 47	1 20	25 18	3 20	52 45	Fourth.
5	Job, Ernani (Bellinzona)	21 33	zero	20 55	11 0	53 28	Fifth.
6	Balsamo, Pasquale (Adriatic Railway)	22 27	zero	24 0	9 0	55 27	Sixth.
7	Gentile, Ernesto (Cap. Engineers)	23 55	0 20	22 45	9 20	56 20	Hon. mention.
8	Vetrano, Guiseppe (Messina)	27 33	4 20	21 27	3 20	56 40	„
9	Perego, Arturo (Mediterranean Railway)	23 21	0 20	24 25	10 0	58 6	„

The prizes were in two series of equal value, one series for either system. The following is a list of the series :—

1. A gold medal given by the Minister of Posts and Telegraphs, an artistic object given by the Organising Committee, and a diploma.
2. A silver medal given by the Minister of Posts and Telegraphs, an *objet d'art* given by the Organising Committee, and a diploma.
3. A silver medal given by the Minister of Posts and Telegraphs of Italy, an *objet d'art* given by the Organising Committee, and a diploma.
4. A silver gilt medal given by the Committee of Organisation, and a diploma.
5. A bronze medal given by the Organising Committee, and a diploma.
6. A bronze medal, and a diploma.
7, 8, and 9. Honourable mentions.

SOME NOTES ON THE ELECTRICAL MACHINERY AT THE COMO EXHIBITION.

By KENELM EDGCUMBE, Assoc.M.Inst.C.E.

(*Concluded from page* 310.)

Coming now to the electrolytic apparatus itself, the latest type is shown in fig. 12. As will be seen, each of the two gases is collected in a separate chamber. Fig. 13 shows a

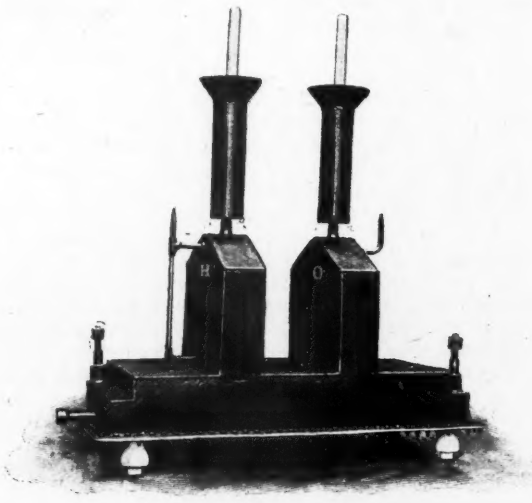


Fig. 12.

section through one of these, though of a slightly modified type. The electrodes consist of plates of sheet-iron, the anodes and cathodes alternating with one another and being connected in parallel. The distance from one plate to the next ranges from 10 to 12 mm. As will be seen from fig. 13, each electrode is in a separate compartment, also formed of sheet-iron, and perforated with 1 mm. holes to allow of the free passage of the electrolyte. These partitions are shown at E. All the compartments containing anodes communicate with the reservoir, G, by means of the small holes, F. From here the oxygen is led off through a tube (the junction being water sealed) to the gasometer. The hydrogen is in the same way led from the cathode compartments to its gasometer. *b* shows the positive terminal, the current entering the chamber at B. As will be seen, the whole apparatus rests on wooden blocks in the vessel, A, and in this respect differs from that shown in fig. 12, which is entirely self-contained. The chief feature about this apparatus is the use of metallic diaphragms. The advantages gained are, firstly, longer life, and secondly, greatly reduced resistance, owing to the large holes employed. The diaphragms, of course, do not form part of the electric circuit, as, in order to do so, they would require an additional voltage equal to that necessary for the electrolysis of water. In spite of

the large holes which are employed in the diaphragms, the separation of the gases is found to be very perfect, the hydrogen containing about 1 per cent. of oxygen, and the oxygen from 2 to 3 per cent. of hydrogen. The electrolyte employed is a solution of caustic soda of 25° Beaumé. The voltage required in all cases is only 2·2 at 77° F., or 1·8 volts at 165° F. The apparatus shown in fig. 12 takes 400 amperes at a current density of ·13 ampere per square inch. The total weight is 200 lbs., and the output per 24 hours amounts

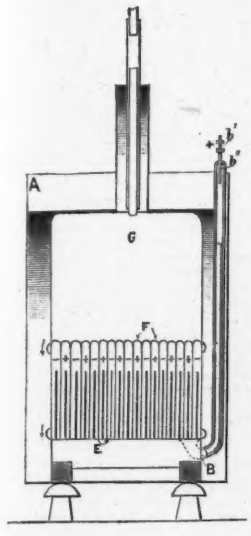


Fig. 13.

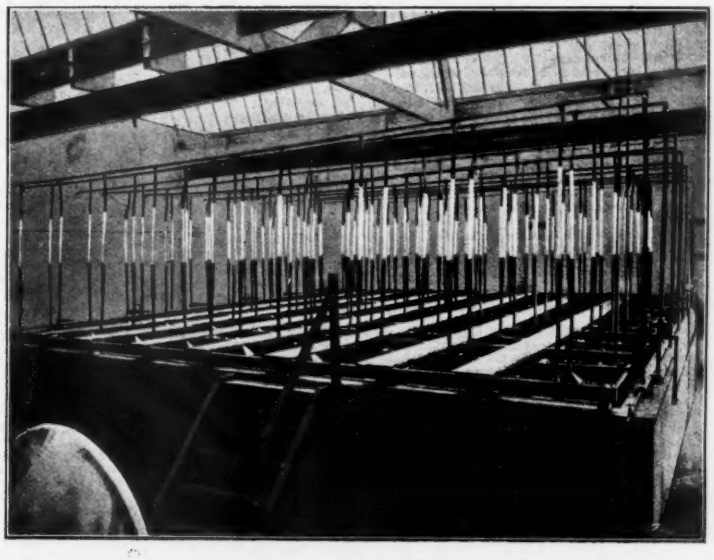


Fig. 14.

to 59 cubic feet of oxygen, and 118 cubic feet of hydrogen. The energy required is thus 400 × 2·2 × 24 = 21·12 units, or ·358 unit per cubic foot of oxygen.

Fig. 14 shows a large plant belonging to the Soc. Anon. Oxhydrique, of Brussels. This company retails the compressed gases at the following prices:—Oxygen, 8 francs per cubic metre, and hydrogen at 3 francs per cubic metre. In Italy, also, the War Department have lately laid down an electrolytic plant for the production of hydrogen for filling military balloons.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

16,464. "Improvements in or connected with overhead collectors for electric railway vehicles." H. H. Hall and R. J. Urquhart. Dated August 14th.

16,492. "Improvements in or relating to apparatus for the suspension of wire cables and the like." E. Bennett. Dated August 14th.

16,494. "Improvements in or relating to automatic cut-off devices principally designed for controlling the flow of fluids and electric currents." H. L. Groome. Dated August 14th. (Complete.)

16,548. "Improvements in rails for electric trams, railways, and for other similar suitable purposes." W. Buck, T. L. Patchett, and B. W. Shaw. Dated August 15th.

16,555. "Improvements in the reduction of aluminium by electrolysis." F. A. Gooch. Dated August 15th. (Complete.)

16,569. "Improvements in accumulator electrodes." R. A. Katz. Dated August 15th.

16,584. "An electric light or lamp." H. L. Arnold and J. W. Graydon. Dated August 15th.

16,600. "Improvements in the manufacture of earthenware troughs for carrying electric cables and analogous purposes." G. H. Nisbett. Dated August 16th.

16,627. "Improvements in electric arc lamps." J. Lesthevenon. Dated August 16th. (Complete.)

16,628. "Improvements in arc lamps." J. D. F. Andrews. Dated August 16th.

16,629. "Improvements in electric signs or signals." J. D. F. Andrews. Dated August 16th.

16,636. "Improvements in electrical accumulator batteries." Dated August 16th. (Complete.)

16,648. "Improvements in holders for the shades of incandescent electric lamps." R. J. Liebisch. Dated August 16th.

16,650. "Improvements in conduits suitable for electric mains." S. Petersen. Dated August 16th.

16,690. "A new or improved composition for use as an electrolyte in batteries or cells." J. Byrant. Dated August 17th.

16,739. "Improved contact system for electrical railways." W. Grunow, jun. Dated August 17th (Complete.)

16,743. "Improvements in holders for incandescent electric lamps and shades." R. J. Liebisch. Dated August 17th.

16,749. "Improvements in incandescent electric lamps." J. R. Schauer. Dated August 17th.

16,796. "Improvements in or relating to conduits for underground electric cables, telephone, or telegraph wires, or for conveying fluids." G. H. Cullen. Dated August 18th.

16,820. "Electrically-controlled design reading apparatus." B. J. B. Mills. (L. David and T. David, France.) Dated August 18th.

16,824. "Improvements in apparatus for electro-chemical and electro-thermic melting operations especially for the production of calcium carbide." E. Grauer. Dated August 18th.

16,885. "Electric loopup." G. Tarry. Dated August 19th.

16,854. "Improvements in connection fittings for various electrical purposes." R. F. Hall. Dated August 19th.

16,859. "Safety guard for trolley rope on electric trams or other motors." J. Costigan. Dated August 19th.

16,878. "Telephonic apparatus for transmitting and receiving messages simultaneously to and from several distant stations." Siemens, Bros. & Co., Limited. (Siemens & Halske, Actien Gesellschaft, Germany.) Dated August 19th. (Complete.)

16,879. "Method for dividing an alternating current into two currents whose phases are shifted relatively to each other through a determined angle." Siemens Bros. & Co., Limited (Siemens & Halske, Actien Gesellschaft, Germany.) Dated August 19th. (Complete.)

16,889. "Improvements in electrical transformers." A. F. Berry. Dated August 19th.

16,898. "Improvements in pneumatic controlling mechanism for electric railway cars." S. H. Short. Dated August 19th. (Complete.)

ELECTRICAL PATENTS OF 1885 EXPIRING IN SEPTEMBER, 1899.

We are informed by W. P. Thompson & Co., that about 60 applications for electrical patents were filed in September, 1885, of these some were never completed, and of those that were only one has been maintained to run its full term, viz., 14 years, and being of considerable interest we give a short abstract of it below:—

10,451. "Improvements in the manufacture of metal pans, cylinders, boilers, containers, or receptacles." F. E. Elmore. Dated September 3rd, 1885. Boiling pans, pans, cylinders, hollow-ware, &c., are produced by the electro-deposition of a metal, generally copper, upon suitable moulds, as described in specifications Nos. 1,737, 4,499, and 8,707, A.D. 1885. The mould is prepared by coating it first with a film of adhesive and then a film of non-adhesive copper; it is then mounted on the shaft and immersed in the bath. The mould is then connected with the negative pole of a dynamo or other source of electricity, the positive pole being connected to strips of copper, or of carbon, lead, or other insoluble substance; the strips follow the form of the mould as nearly as possible, and are all placed at the same direction from the shaft. The shaft is rotated during the deposition by toothed or belt gearing, the surface of the metal being at the same time acted upon by a burnisher. 2 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

15,168. "A method of measuring electrical power and appliances for that purpose." M. B. Field. Dated June 24th, 1897. Relates to energy meters and electro-meters. Power supplied by an alternating current to any circuit is

measured by the reading of two instruments indicating $(1\ c\ v)^2$, and $(c\ v)^2$ respectively, where c and v are simultaneous, instantaneous values of the current and pressure. In a modification, the second instrument indicates $(v\ c)^2$; in three other modifications the instruments indicate v^2, c^2, and either $(c\ v)^2$ $(c\ v)^2$ or $(v\ c)^2$ from differences of which the power v c may be obtained. A single differential instrument may be used, indicating power directly. The supply mains are connected by the primary of a transformer, and one main continues a low fixed resistance. The transformer has two equal low-pressure secondaries connected through the two circuits of a differential current meter to the ends of the resistance. For the first modified method, the resistance is in two equal halves and the transformer has a single secondary, or is replaced by a single coil, a part of which serves as a secondary. With a single resistance, secondary, and instrument a switch may be used to reverse connections so that the two quantities may be observed successively. With two instruments a switch may be used to change the connections so that they indicate current and pressure separately; from these and the power readings the apparent power supplied, and phase difference may be obtained. Power supplied in any three-wire system is obtained by making separate measurements between each outside main and the third one, or a single instrument may be used. The instruments are preferably hot-wire or electrostatic. The movable part is connected to the central main, and carries plates within two pairs of fixed cells, which are connected separately to the terminals of fixed resistances in the outer mains. Such an instrument may be used on a two-wire system. A differential instrument may be made with two hot wires or other devices acting oppositely through two pulleys and cords on one indicator. Two distinct instruments may be mounted in one case, with pointers indicating on one scale. To fix the pointers while their positions are observed, two strips of paper are pressed against them by shafts which are cranked and connected by a link to a handle.

15,237. "Improvements in electrical switch apparatus for the points and crossings of electrical railways or tramways with underground conductors." Siemens Bros. & Co., Limited. (Siemens & Halske.) Dated June 25th, 1897. Relates to switches for the rails and conductors of electric railways and tramways on the conduit system. Conductors, permanent way. The point of the rail is pivoted, and the point of the conductor is pivoted so that it has a greater angular throw as the two are connected so as to move simultaneously by the insulating piece. The end of the conductor point is insulated by a part, and short lengths of the conductors alongside are also insulated, the lengths of the portions being greater than a part, so that any sparking may occur at the part rather than at the point of the conductor. The electric connections on a cross-over road cause a change of polarity as the car passes over the points. 3 claims.

15,159. "Improvements in arc lamps." P. Duffos. Dated June 24th, 1897. Relates to arc lamps.—A ratchet escapement lamp is constructed. The upper carbon of which is carried by an insulated holder on a frame which slides in tubes and may be provided with anti-friction rollers. Connection with it is effected by a flexible conductor. The lighter, lower carbon holder is attached to a rod, within the tube, and connected through the frame. The holders are hung by a chain or cord from a pulley attached to a toothed wheel, and supported in fixed bearings. A frame, movable about the same axis, carries a pinion in gear with the wheel and attached to a ratchet wheel with deep teeth. This is normally held in engagement with a stop by a link connecting the frame with a weighted or spring actuated lever. A curved iron plate forming part of the lever enters a shunt solenoid which turns the frame and the wheel when the ratchet is in engagement with the stop and the terminal difference of potentials sufficient, thus bringing the carbons together until the ratchet leaves the stop. The ratchet may be attached to a heavy fly-wheel to check its rotation when released. 2 claims.

15,328. "Improvements in apparatus for operating two or more electric current switches simultaneously or periodically." O. D. Lucas. Dated June 26th, 1897. Relates to operating mechanism for resistance and other electric switches when employed for making and breaking signal or other electric currents in predetermined order, such as those applied to illuminated signs and other signalling and switching devices. A section of the apparatus is shown in which a row of switches is provided with levers. Each lever is provided with a guide swell, an oblique recess and a groove in the end. The levers are operated to close or open the switches by the motion of the levers, which are connected by a link and have controlling springs. The levers have operating studs or rods for engaging with the levers. A selecting device, consisting of a slotted rotating disc is operated by a ratchet mechanism or hand lever. Lifting rods are provided with projections which pass through or are depressed by the disc. The other ends of the lever allow the levers to be in their operative position or to be raised to the inoperative position. The mechanism may be operated by a motor or by hand, and indicators may be employed with the switches. 4 claims.

15,396. "Improvements in or relating to carbons for electric welding, brazing, and the like purposes." G. W. de Tunzelmann. Dated June 28th, 1897. A metallic oxide or oxides, such as the oxides of iron, copper, lead, or manganese, are incorporated or mixed with the carbon to form the electrodes or carbons for use for electric welding, brazing, and like purposes. The object is to reduce the excess of free carbon in the arc, and also to produce an arc in which the heat is more equally diffused owing to the presence of a metallic vapour. 1 claim.

15,411. "Improved electric igniter for gas engines." R. Bosch. Dated June 28th, 1897. Relates to a dynamo for generating an electric current for igniting in gas engines. The armature is stationary, and its insulated terminal can be rigidly attached to the conducting-wire or to a terminal on the framing. Magnets with or without sole-plates embrace the armature, and between them soft-iron strips are mounted and oscillate being attached to the end discs on the shaft. 2 claims.

15,418. "Improvements in or connected with electrical distribution fuseboards." Veritys, Limited, and M. B. Cotterell. Dated June 29th, 1897. A main lead is connected to several screw terminals so that the fuses are in each branch. Each fuse is held by means of C springs and clamping nuts. Projections and recesses may be employed on the springs and nuts to produce a locking action. The fuses are supported on porcelain troughs separated by glass washers, and carried by rods threaded through holes in the blocks and washers. The rods are coned at one end, and have extra locking-nuts to hold the bars rigidly in place across the iron case. 5 claims.

15,472. "Improvements in electric furnaces and processes of treating ores." G. B. Burton. Dated June 29th, 1897. Electric furnaces.—Ores are dried, roasted, and smelted in furnaces in which the heat is produced by passage of electric current either through a metal or other conducting coil, or a carbon rod, covered by the ore, or through a body of ore placed between two electrodes. Reducing agents may be mixed with the ore. The furnace may also be used for making calcium carbide. Alternating current is preferably used, and is regulated to increase the heat in successive stages of the treatment. In the furnace a glazed fireclay body contains a perforated hollow helix on a pipe which is rotatable by gearing to stir the ore. A coil of pipe may replace the pipe and helix. The pipe, &c., may be made of a copper-antimony alloy. Electric current is passed through the pipe and helix by terminals and clamps. Air may be introduced through the pipe by a lower valve, and gases are delivered through an upper valve, or through a valve and a tube made in sections. This contains baffles to stop articles deposited by the gas, and may be provided with magnets to stop magnetic particles; it ends in liquid in a tank. Liquid products are discharged at a tapping hole in the base, which rests on radially removable supports. When the current is to be passed through the ore itself, the tube is divided, each part carrying a perforated disc electrode in place of the helix, the upper part of the tube, with its electrode, is vertically adjustable. 25 claims.

15,488. "Improvements in apparatus or means for charging accumulators." H. B. Cox. (The Cox Thermo-Electric Company.) Dated June 29th, 1897. In order to charge accumulators from a generator of low voltage, the cells are arranged singly or in groups which are successively charged. The cells are arranged in groups which are connected by conductors alternately to contacts insulated from one another but cross-connected by conductors. Rubbing on these contacts are bushes mounted on the rotary shaft. Current is supplied to the bushes from the generator. The shaft is rotated by clockwork or other mechanism; each group of cells is thus charged for a certain time. The pairs of contacts may be arranged otherwise than in a ring, the bushes being successively moved over them. 5 claims.

15,490. "Improvements in electric heaters." G. B. Fraley. Dated June 29th, 1897. Current is passed through a series of carbon blocks, or a continuous carbonised conductor, enclosed by firebrick blocks. In the stove described, a hollow firebrick block in a casing has channels of U-form in its sloping front, containing balls or other blocks of carbon; the channels are open to some extent, before and behind the balls. The channels terminate in metal tubes which contain weights to press the balls together, and are connected with electric supply conductors. Both light and heat are produced by this apparatus, some combustion taking place; the ashes fall inside the block. When the weights have fallen so that pins on them rest on the bottom of slots in the tubes, more conducting blocks are introduced, after removing covers and the weights. The casing front is closed by doors containing mica sheets. Carbonised paper or like conductor is enclosed in grooves between blocks, and connected to terminals; the blocks are bolted together. Metal sheet conductors may be enclosed similarly between blocks, near the face of these, and are provided with rearward extensions to hold them in place. Or conductors may be formed by painting mixtures of powdered carbon and saccharine material into grooves in the blocks. Such apparatus is applicable for broiling or cooking. 17 claims.

15,491. "Improvements in electric heating apparatus." G. B. Fraley. Dated June 29th, 1897. Current is passed through a resisting wire coiled on asbestos or other non-conductor surrounding a mica-covered cylindrical core. The wire is also covered with a thick layer of a mixture of talc, silicate of soda, and carbonate of soda or other insulating material not shown. The core may be of copper slit longitudinally and perforated to pass a limited air current. Reflectors or baffles are fixed within or near its ends. The core is supported by a cap adapted to screw into a metal sleeve in a porcelain or other holder. The upper end of the wire is connected electrically to the core, cap, the sleeve, and a terminal; the lower end is connected to a central screw on a porcelain disc, this making contact with a plate and second terminal in the holder. For alternating currents the core is provided with slits extending partly along it from opposite ends alternately, so that the heating currents may be induced in it, or the core may be a conducting plate rolled up into several layers with intervening insulation, the inner and outer ends of the plate being connected electrically by rivets. In this form the core is carried in clamps near its ends. One clamp is insulated, and the ends of the wire are connected with the clamps. Additional layers of wire may be used, separated by asbestos. 15 claims.

15,503. "Improvements in electric arc lamps." O. Imray. (The Pennsylvania Salt Manufacturing Company.) Dated June 29th, 1897. Relates to a clutch-lamp provided with improved feeding mechanism. The upper carbon carrier passes between V-shaped jaws carried by levers which are pivoted on a disc, and are supported by links on the core of a solenoid. When the core falls sufficiently the disc rests on stops, and the jaws release the rod. The upper carbon passes through a lid having a flange resting on the inner globe, the dimensions being such as to permit some lateral play of the cover with the carbon. The inner globe may be held by a ring bearing on a shoulder in it, and screwing on a screw surrounding the lower carbon-holder. This is attached to the frame of the lamp by insulated screws; the carbon is held by a pivoted shutter and clamping-screw. The outer globe is secured in a cup which is supported by a nut and bolt on a part of the frame. The bolt has a cross-head which may be turned and lowered through slots in the part when the outer globe is to be lowered. When in place the nut serves to raise the outer globe into contact with a cover on the lamp frame. A pin and collar limit the motion of the bolt and nut. 6 claims.

15,510. "Improvements in secondary or storage batteries or accumulators and in the manufacture of the same." J. P. Claro, G. E. Hatch, and J. H. Taylor. Dated June 29th, 1897. In making the electrodes, active material is first formed on the metal plate itself by electrolytic action, and then active material or material to be rendered active, in a granular or pulverulent condition, is packed round the plate, and the electrolytic action is continued until the two masses are firmly united together. The plates and the active material are contained in a casing formed of large porous terra-cotta plates made up of separate sections fitted together and having recesses, pits, grooves, or cells, on their inner surfaces to hold the active material, and grooves near their edges for the insertion of thick rubber to make a water-tight joint. The terra-cotta sections are made of different sizes, so that when built up into plates, the horizontal joints in one plate are not opposite those in adjacent plates. The terra-cotta plates have ribs on their outer surfaces, and those in adjacent plates are preferably at right angles to each other. A number of elements so prepared are held between plates of hard rubber by rubber bands. 6 claims.

15,607. "A method of effecting multiplex telegraphic and telephonic communication, and apparatus for that purpose." J. Imray. (La Societe Anonyme pour la Transmission de la Force par l'Electricite.) Dated June 30th, 1897. Relates to a system of multiplex telephony and telegraphy, in which two lines connecting two central stations are provided with synchronously driven distributors, and the various subscribers are connected to single or grouped sectors on the distributors. When telephony and telegraphy are carried on simultaneously, two sets of distributors are employed, the telephone signals being sent on the metallic circuit, and the telegraph signals being sent on the metallic circuit as the line with an earth return. The signals are kept separate by resonators and condensers. The distributors are driven by motors or clockwork, separate sectors being employed for sending the synchronising currents; or the metallic circuit may be used with an earth return, in multiplex telephony, for the motor synchronising circuits, double primaries of transformers being connected in each of the leads. In this case the secondaries are in loops at each end with the distributors and the subscribers. Several arrangements of these circuits are described; in one of them the main line alternating current bell call circuit is arranged as a shunt to the motor circuit. In another form the double wound armature of a continuous current generator for the telephone currents is arranged with one winding in each of the metallic lines. The armatures of the distributor motors are preferably screened with copper end discs and connecting bolts. A telephone relay is described, in which the coil is enclosed in a magnetic shell, the armature carrying a microphone in circuit with a local battery and receiver. 4 claims.

15,609. "Improvements in electrical switches." J. W. Swan. Dated June 30th, 1897. In order to prevent arcing, an insulating wall is arranged between the terminals. Walls or projections are fitted on the base, and separate the terminals. The circuit is completed between the terminals by the bridge, to which a quick break is given by the spring, the handle being formed to give the required play. In a modified form, the wall is circular, one fixed terminal being within and the other without. The bridge is formed with one arm shorter than the other. 2 claims.

1898.

468. "Improvements relating to enclosed motors or dynamos." P. Rosling and H. W. Appleby. Dated January 7th, 1898. A dynamo armature shaft is mounted between the armature and case enclosing the dynamo and the vanes of a fane by which air is drawn into the enclosed casing from the outside atmosphere through a suitable opening which may be provided with a filter of cotton wool applied in a manner so as to extract from the air any moisture, grit, &c., that might be detrimental to the commutator, &c. 1 claim.

632. "Improvements connected with electric lamps and switches." W. M. Walters. Dated January 10th, 1898. The object of the inventions is to provide appliances whereby the illuminations in a room may be regulated. For this purpose a small incandescent lamp is carried in the box provided with the usual contact pieces. The switch lever is so arranged that when the main lamp or lamps is or are switched off the small lamp is switched into the circuit in place of the main lamp. 2 claims.

8,538. "Improvements in and relating to electric heaters." E. F. Porter. Dated April 12th, 1898. Relates to electric heaters, especially to the kind described in specification No. 5,595 of 1891. Consists in making the fan blades themselves of a material which will act as a resistance, and passing the current through conductors on the blades. 9 claims.